US009365343B2

(12) **United States Patent**
Klemm et al.

(10) **Patent No.: US 9,365,343 B2**
(45) **Date of Patent: Jun. 14, 2016**

(54) **DISPENSER WITH MOTOR, GEAR PLATE, AND SNAP FIT CAP**

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(73) Assignee: **S. C. Johnson & Sons, Inc.**, Racine, WI (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 858 days.

(21) Appl. No.: **13/409,759**

(22) Filed: **Mar. 1, 2012**

(65) **Prior Publication Data**

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Related U.S. Application Data

(60) Provisional application No. 61/448,108, filed on Mar. 1, 2011.

(51) **Int. Cl.**

H02K 7/10	(2006.01)
B65D 83/26	(2006.01)
H02K 11/00	(2016.01)
H02K 7/116	(2006.01)
A47K 5/12	(2006.01)
A61L 9/14	(2006.01)
B05B 9/08	(2006.01)
A61L 2/22	(2006.01)

(52) **U.S. Cl.**

CPC ***B65D 83/262*** (2013.01); ***H02K 7/116*** (2013.01); ***H02K 11/0068*** (2013.01); ***H02K 11/30*** (2016.01); *A47K 5/1217* (2013.01); *A61L 2/22* (2013.01); *A61L 9/14* (2013.01); *A61L 2202/25* (2013.01); *A61L 2202/26* (2013.01); *B05B 9/0805* (2013.01)

(58) **Field of Classification Search**

CPC H02K 7/116; H02K 7/10; H02K 5/04; H02K 5/00; H02K 2205/00; H02K 2207/00; H02K 1/18; H02K 11/0068; H02K 7/1163; H02K 7/1166; F16F 2226/044; B65D 83/262; A47K 5/1217; B05B 12/122

USPC ..... 310/68 R, 83, 75 R, 96, 99

See application file for complete search history.

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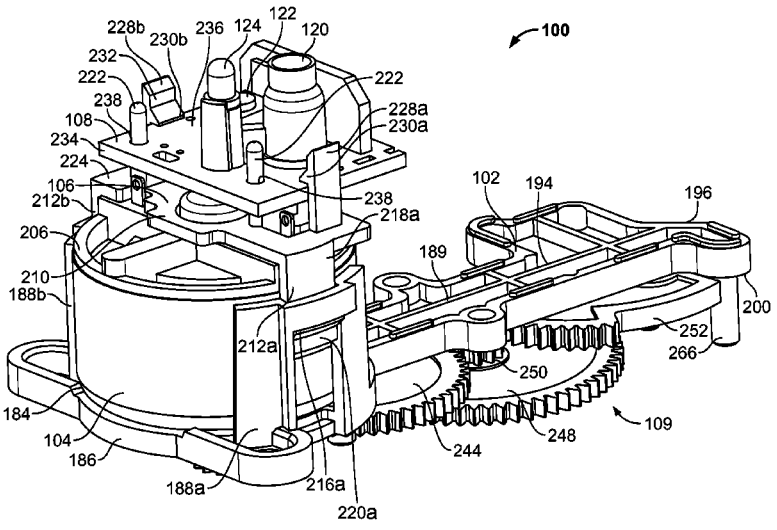
Primary Examiner — Michael Andrews

(57) **ABSTRACT**

An assembly including a drive motor and a gear plate. The gear plate includes a seat for retaining the drive motor. The assembly also includes a motor cap having at least one pawl for snap-fitting into the seat. The assembly further includes at least one post, which is adapted to receive a gear.

20 Claims, 20 Drawing Sheets



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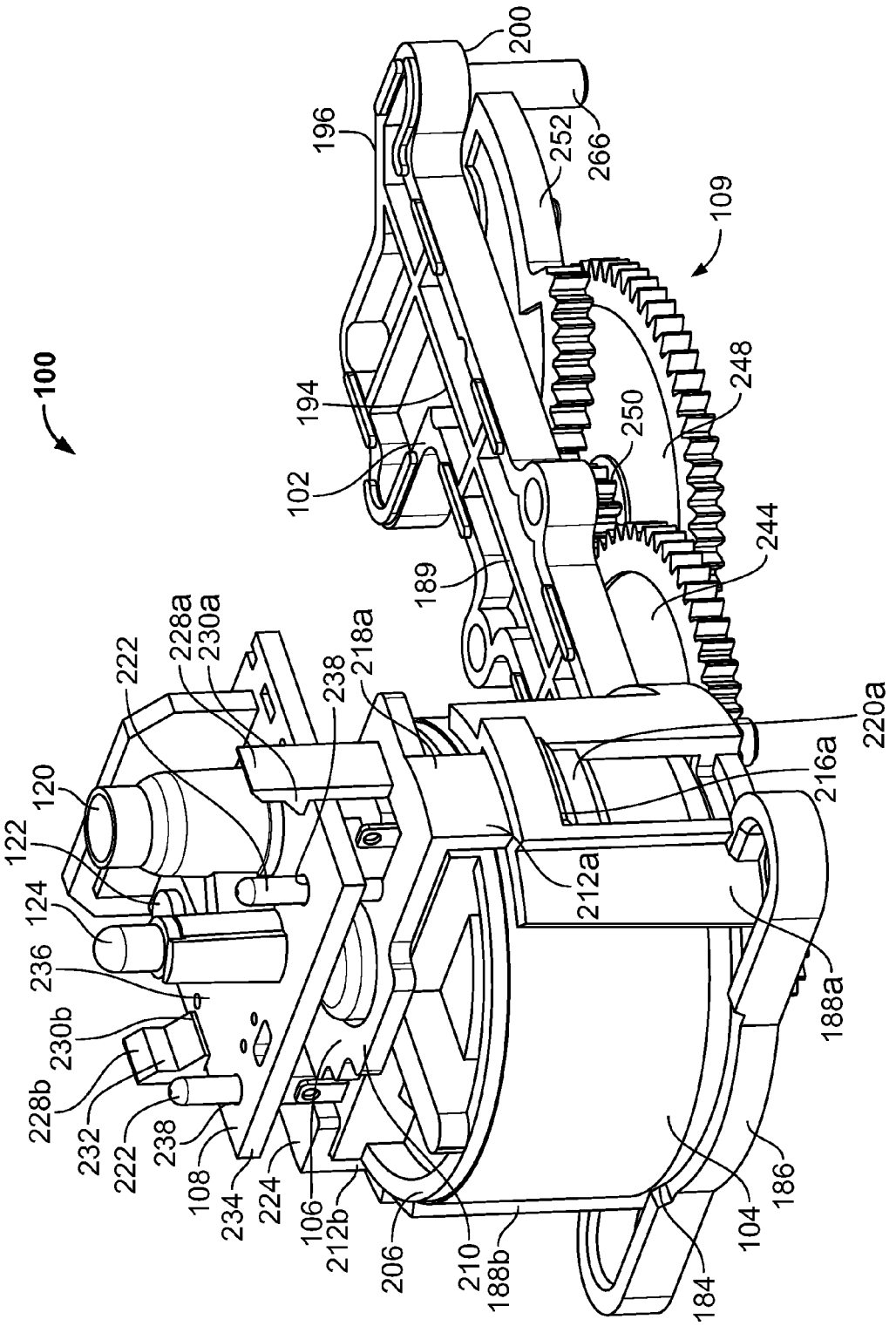
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FIG. 1

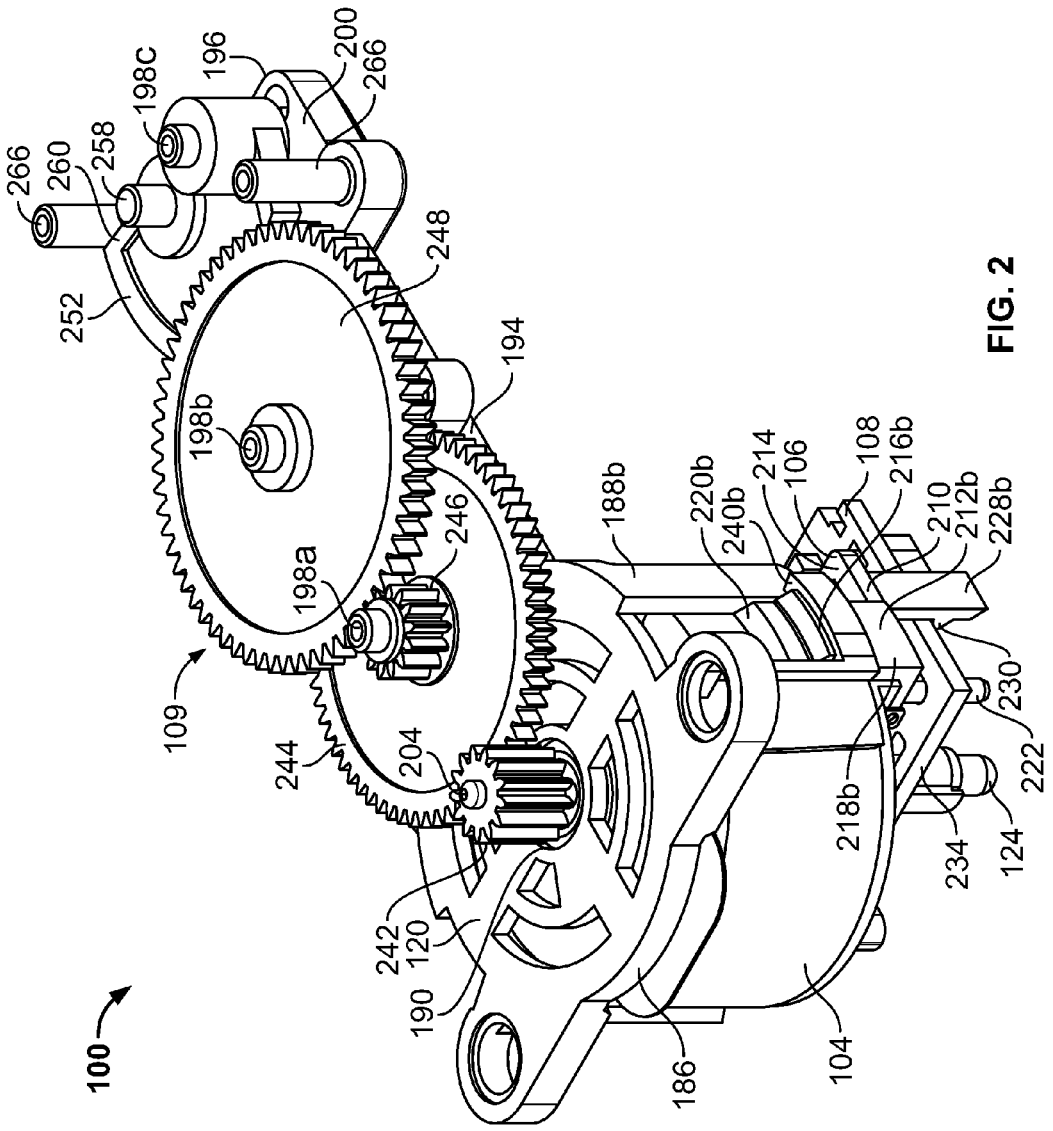
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FIG. 2

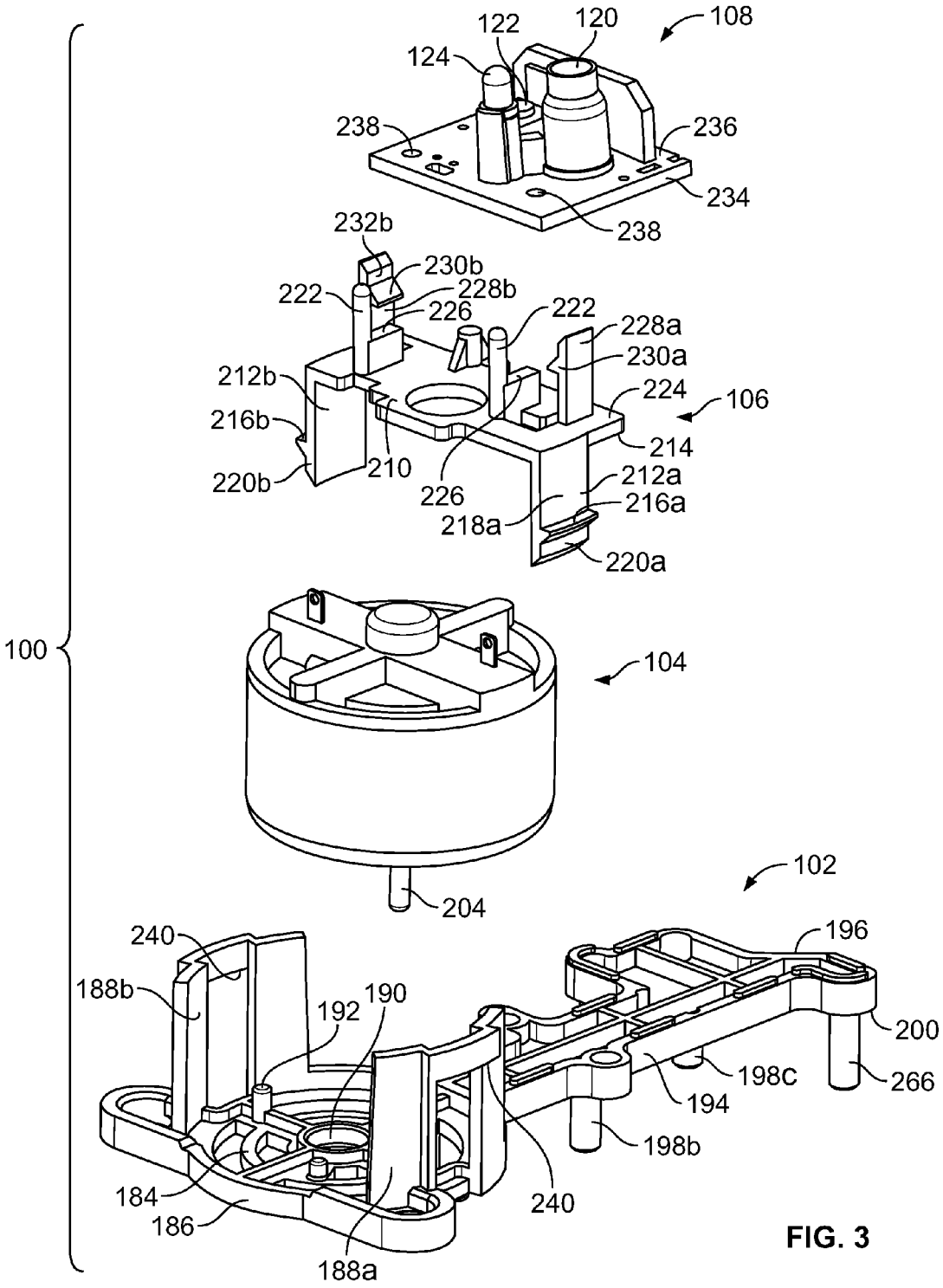
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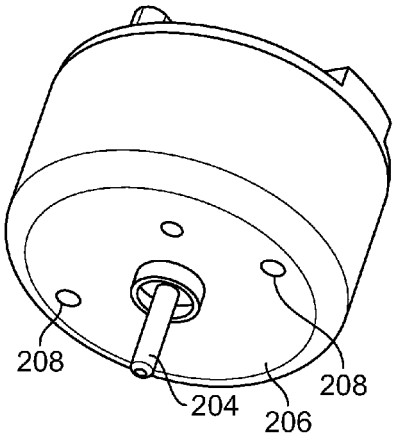
FIG. 3



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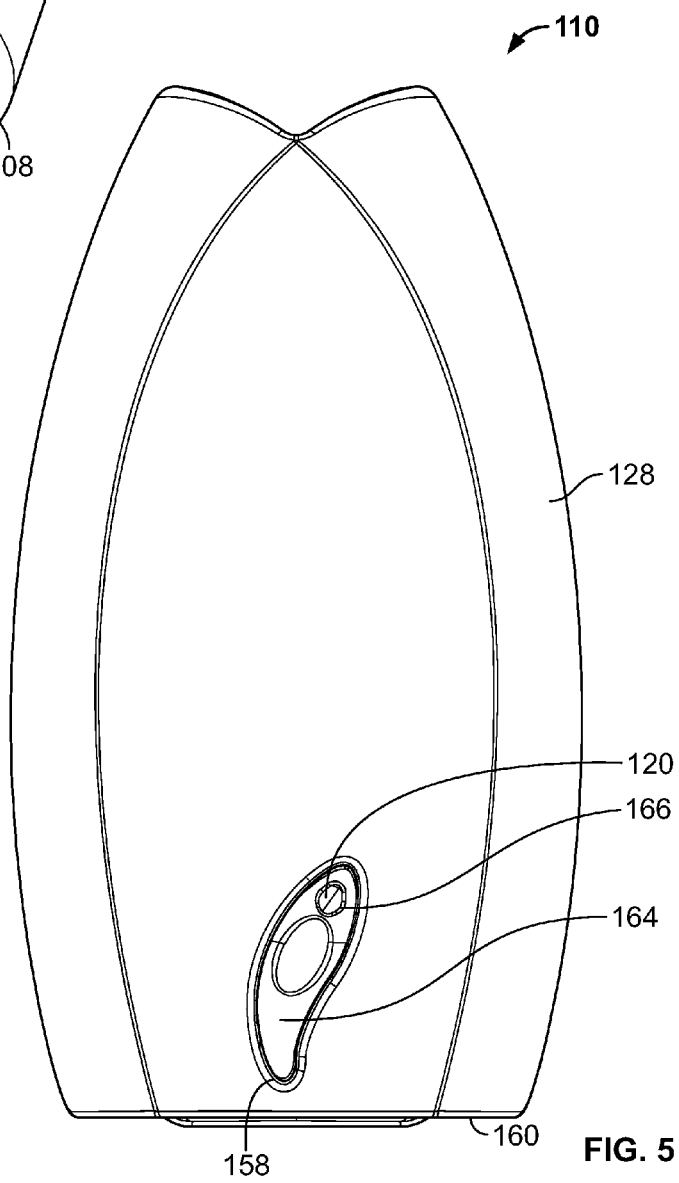

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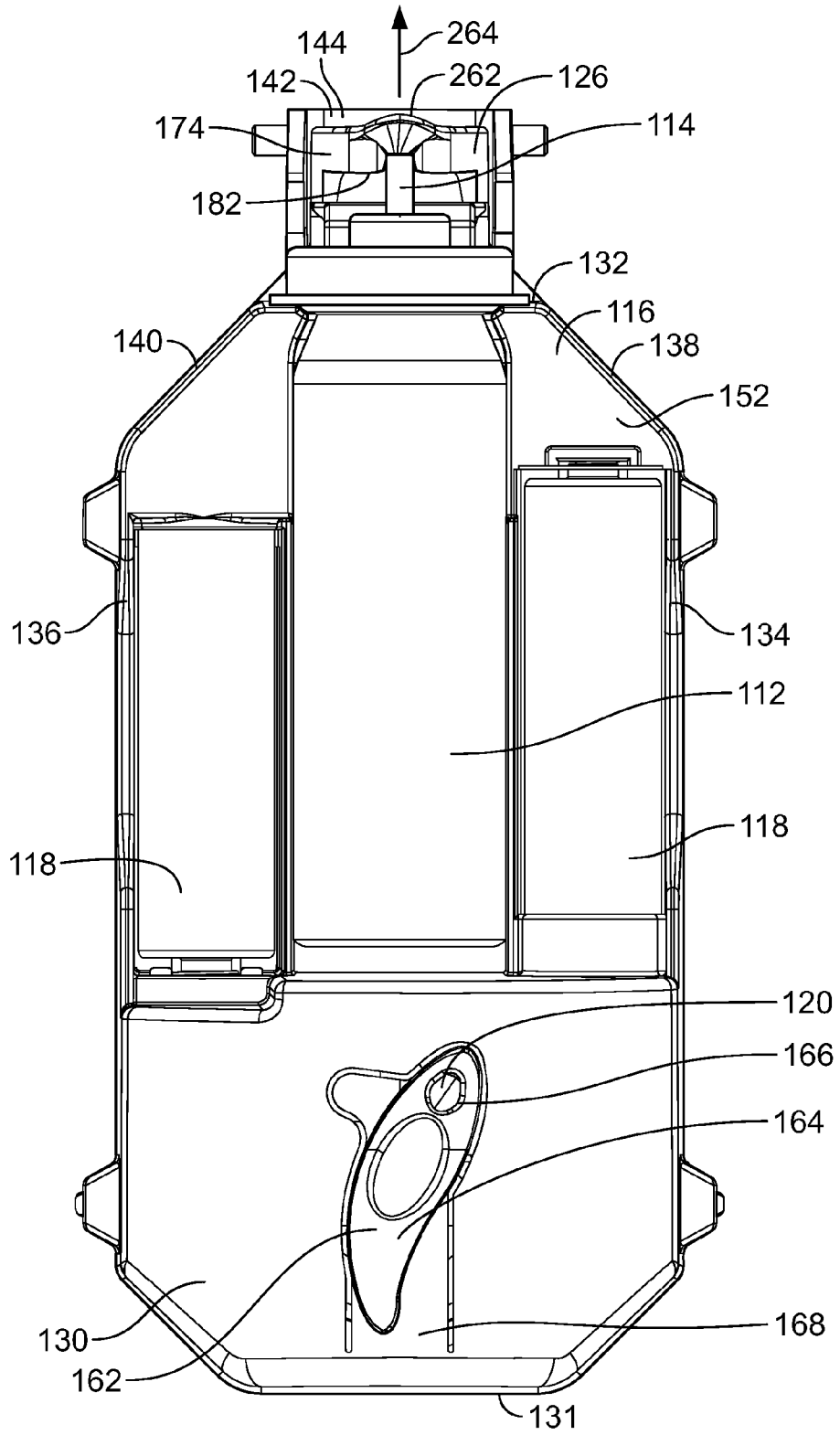
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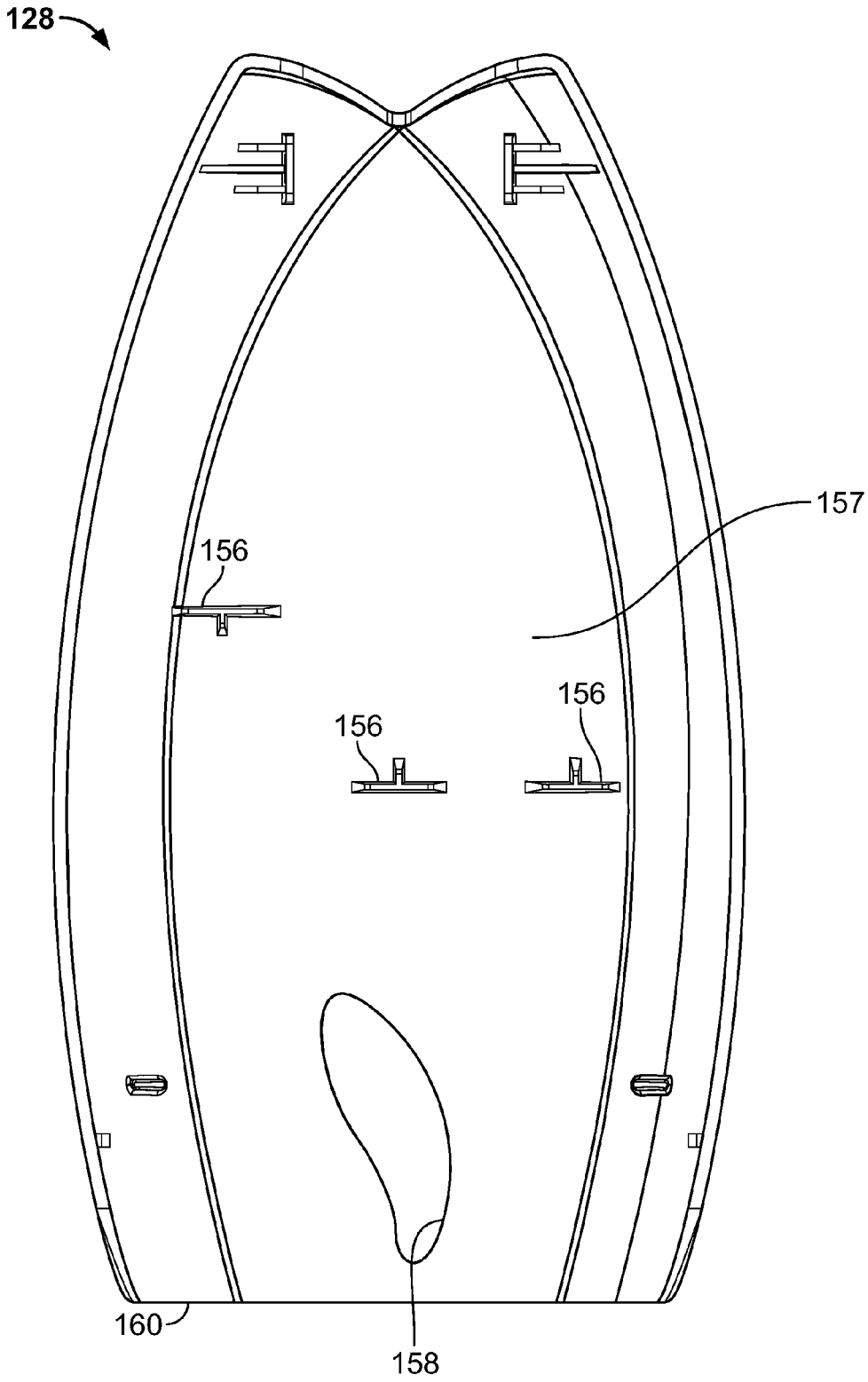
FIG. 6



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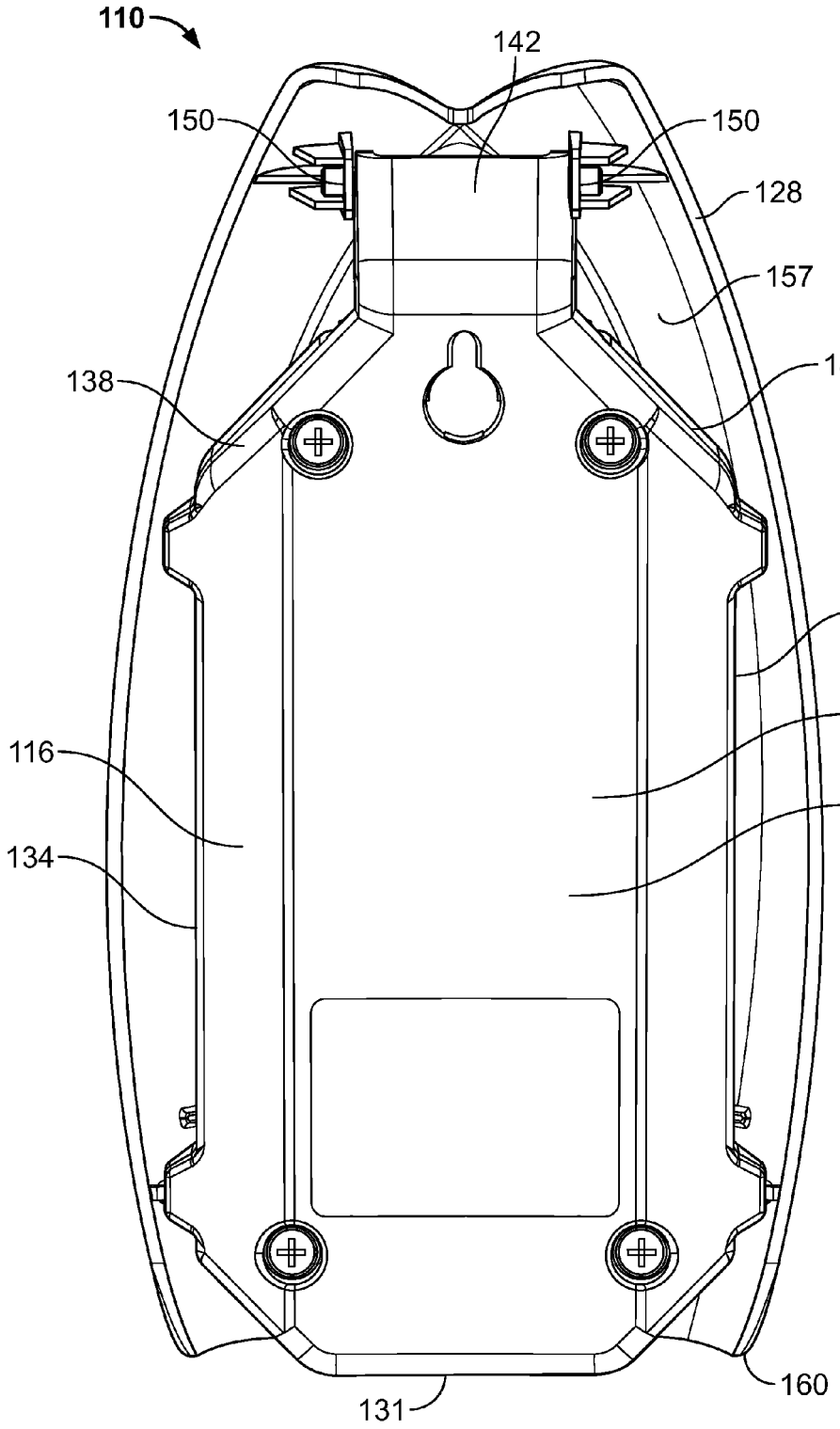

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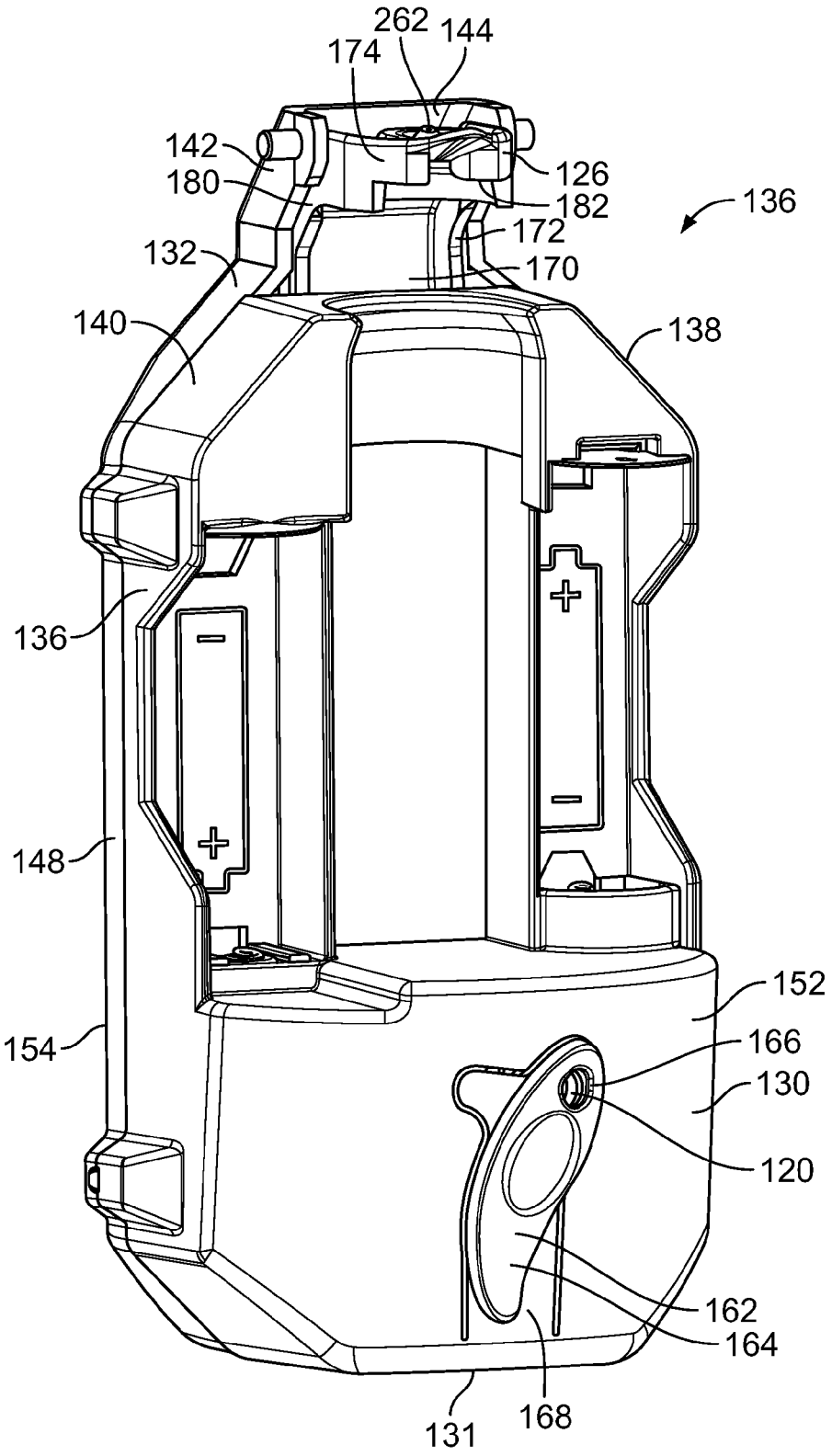
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FIG. 9

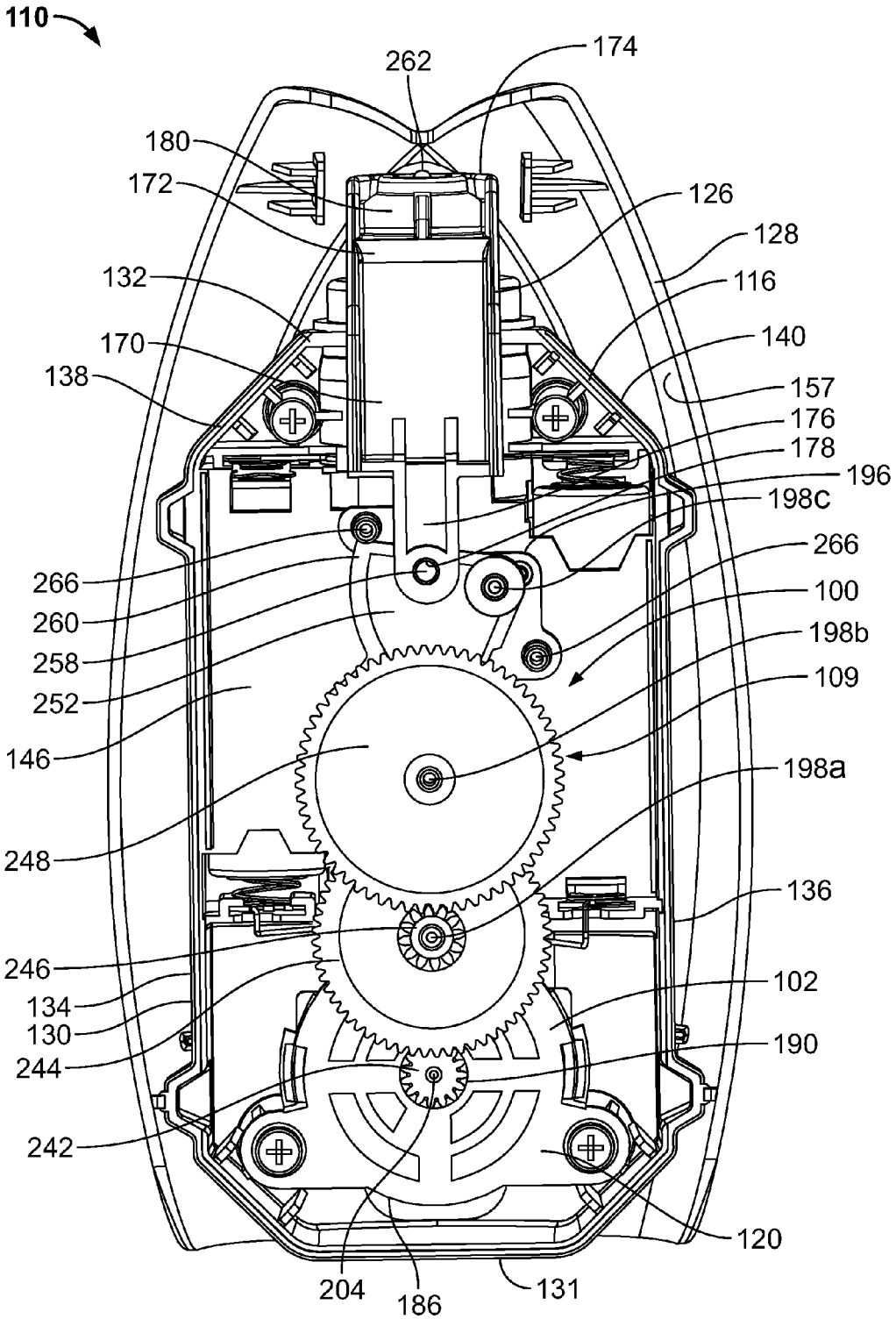
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FIG. 10

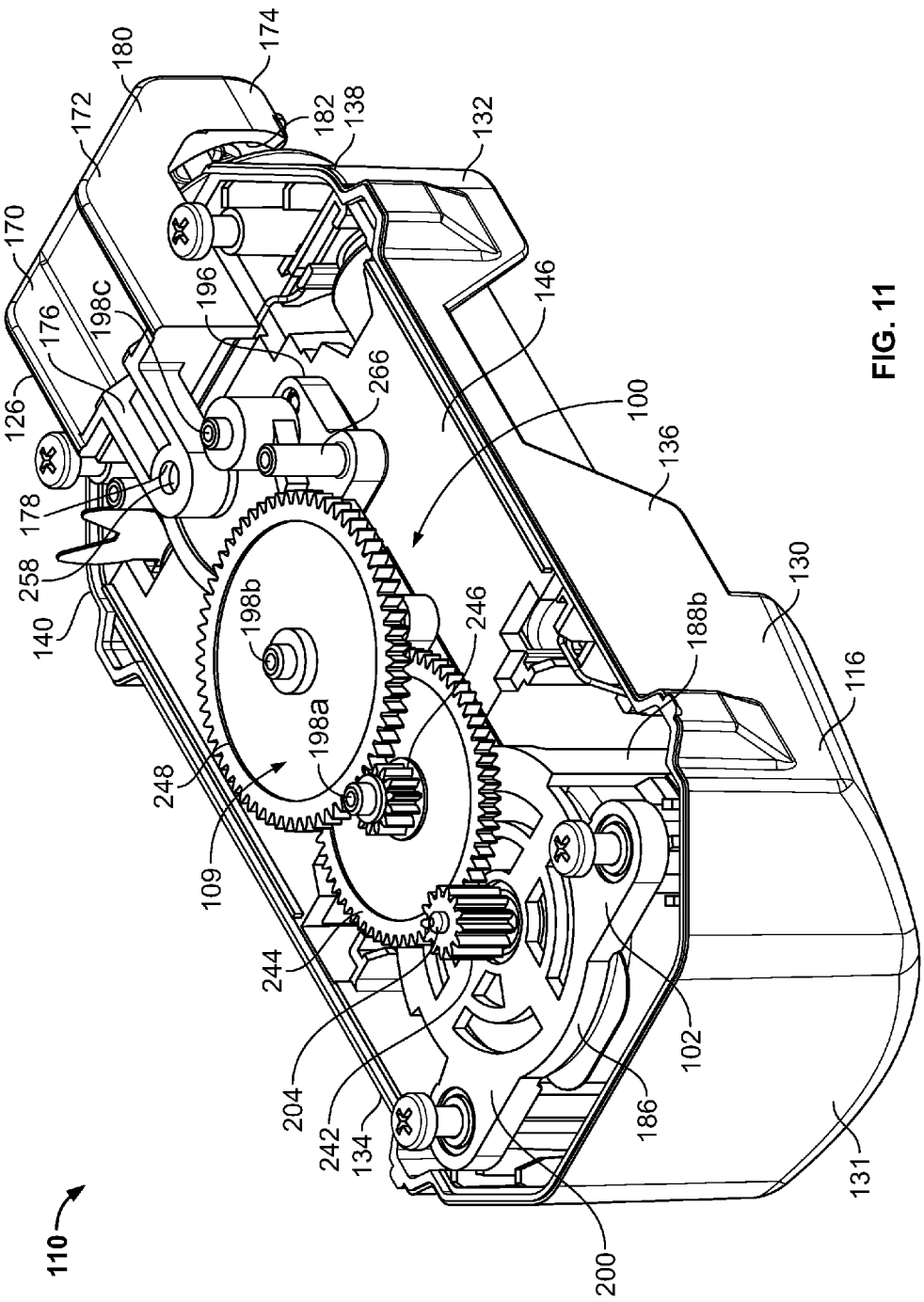
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FIG. 11

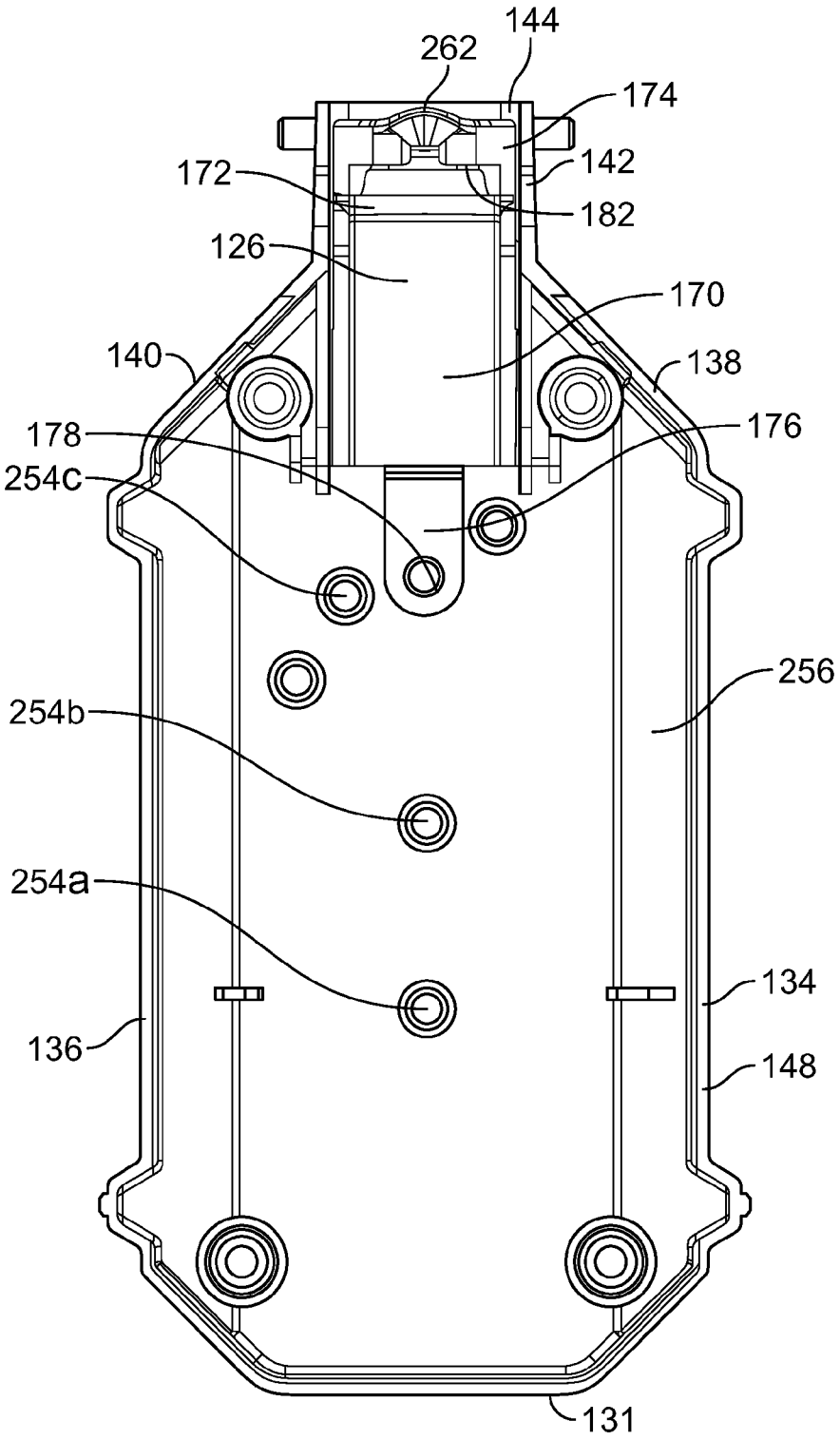
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FIG. 12

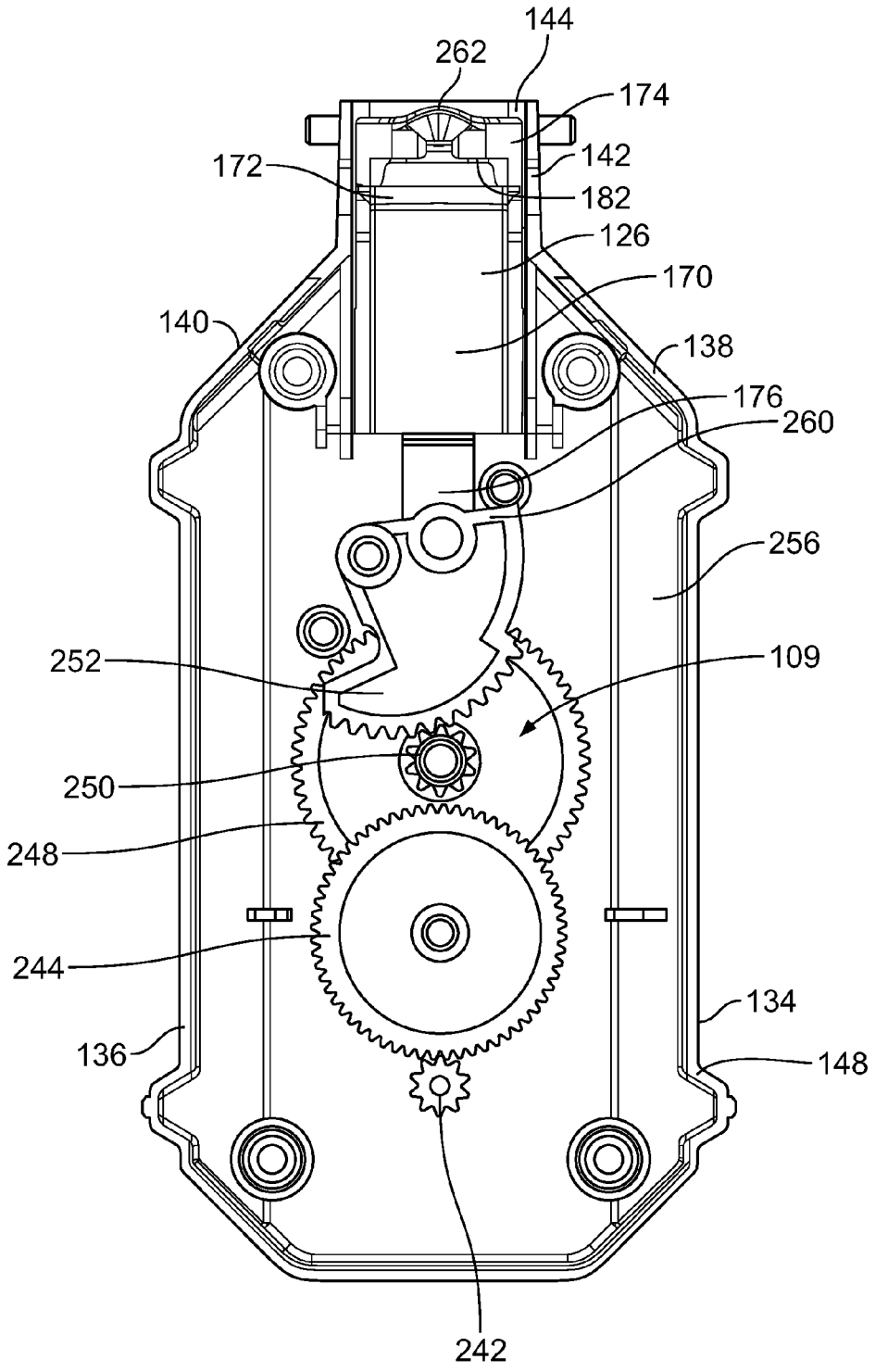
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FIG. 13

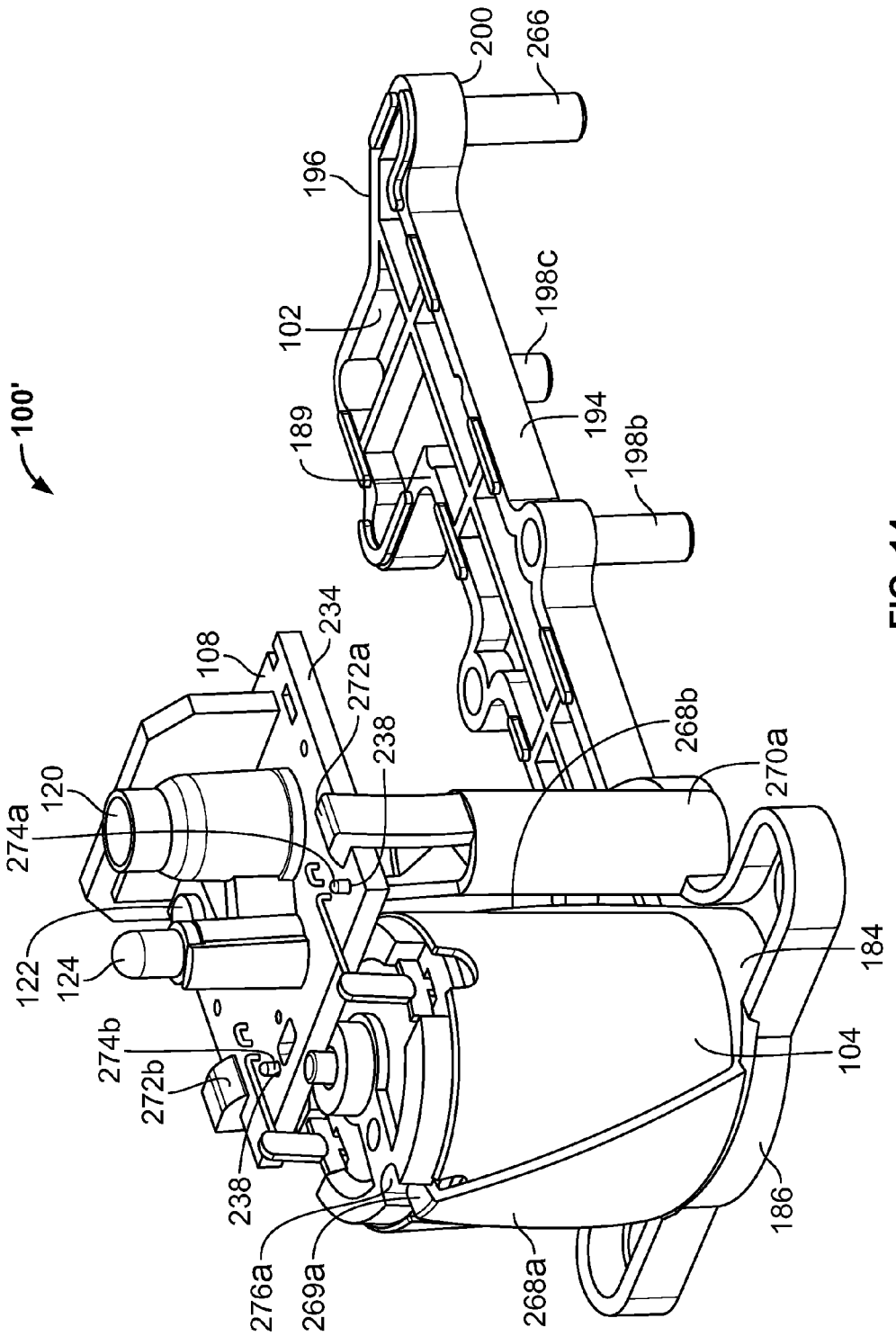
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FIG. 14

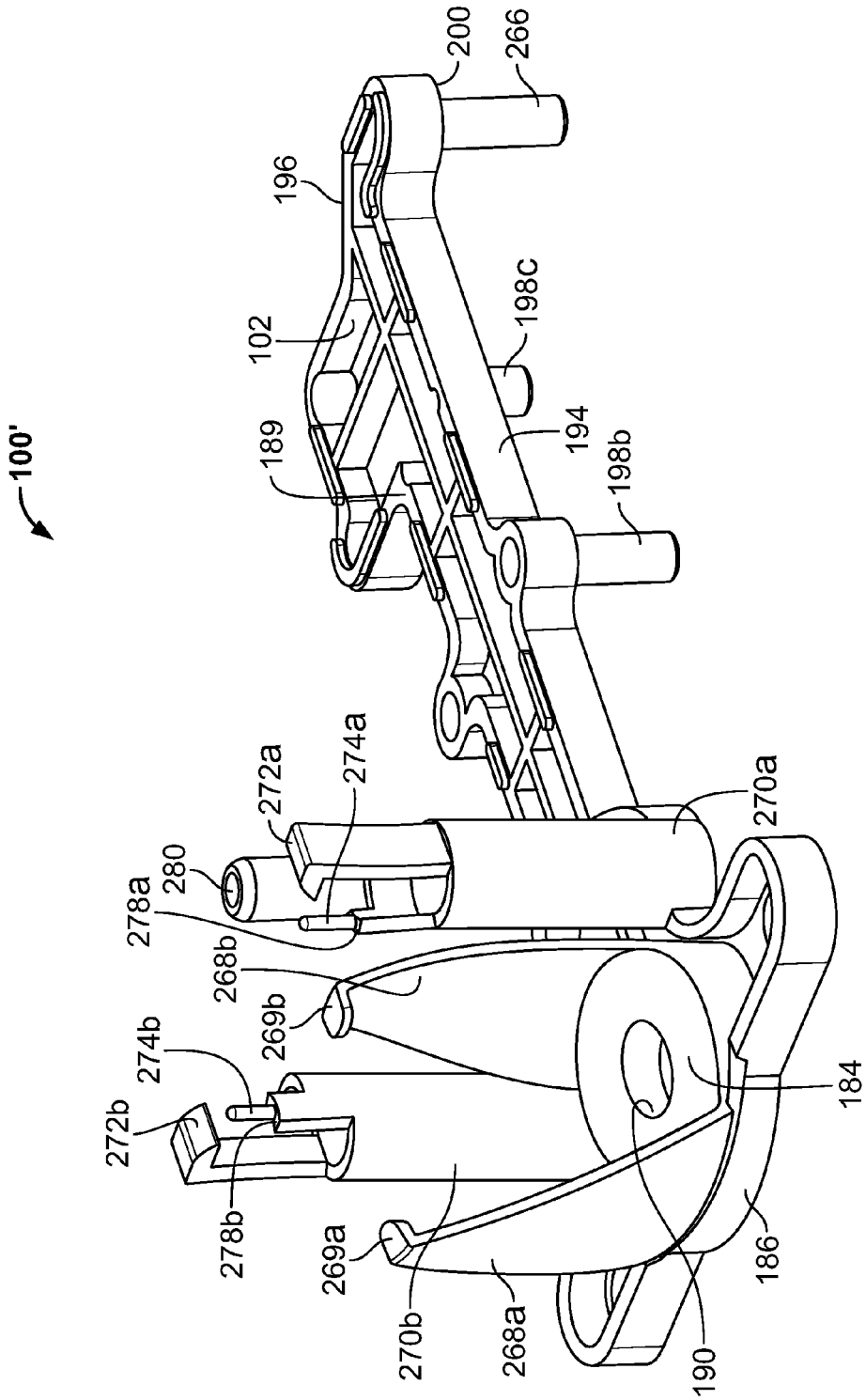
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FIG. 15

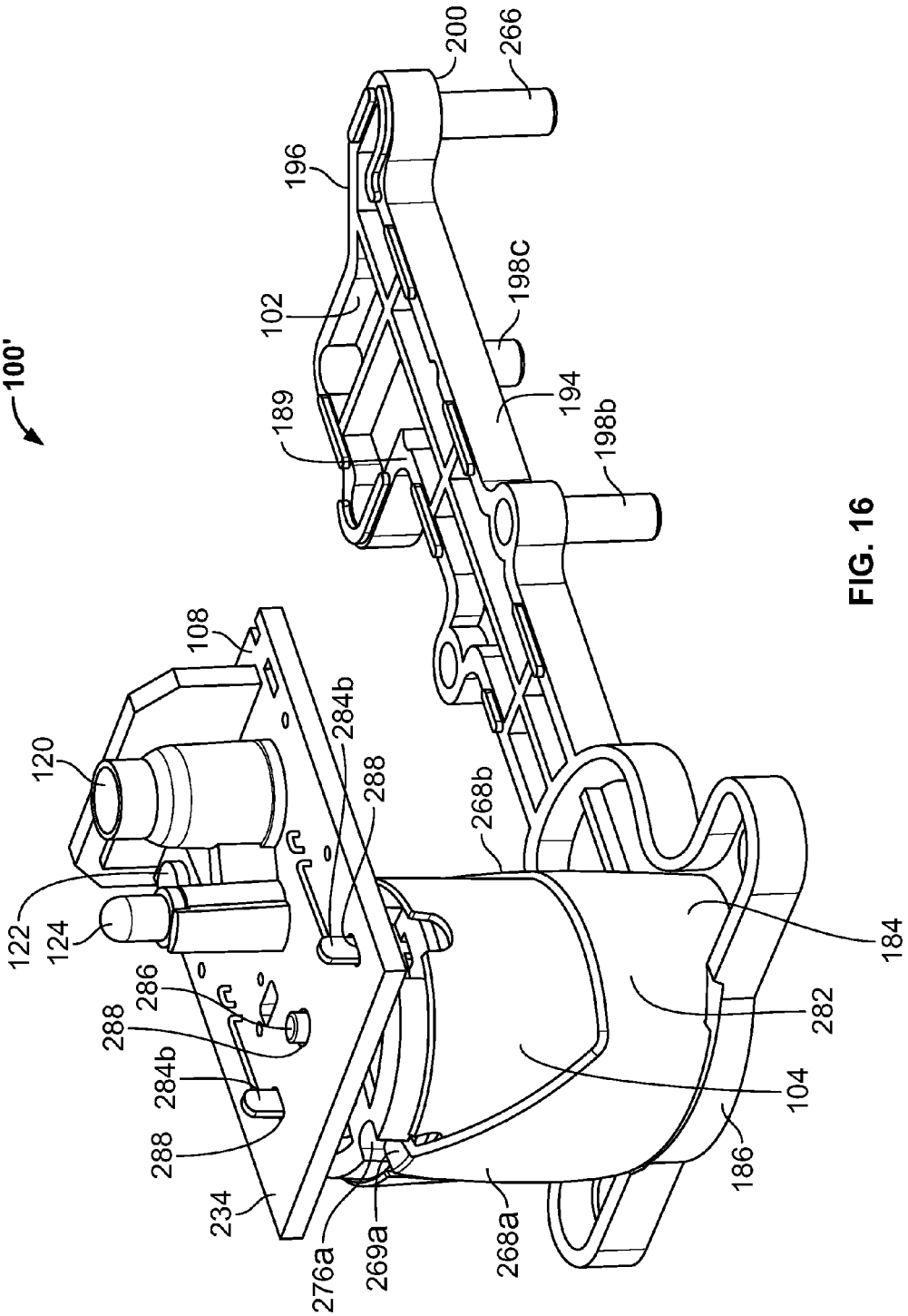
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FIG. 16

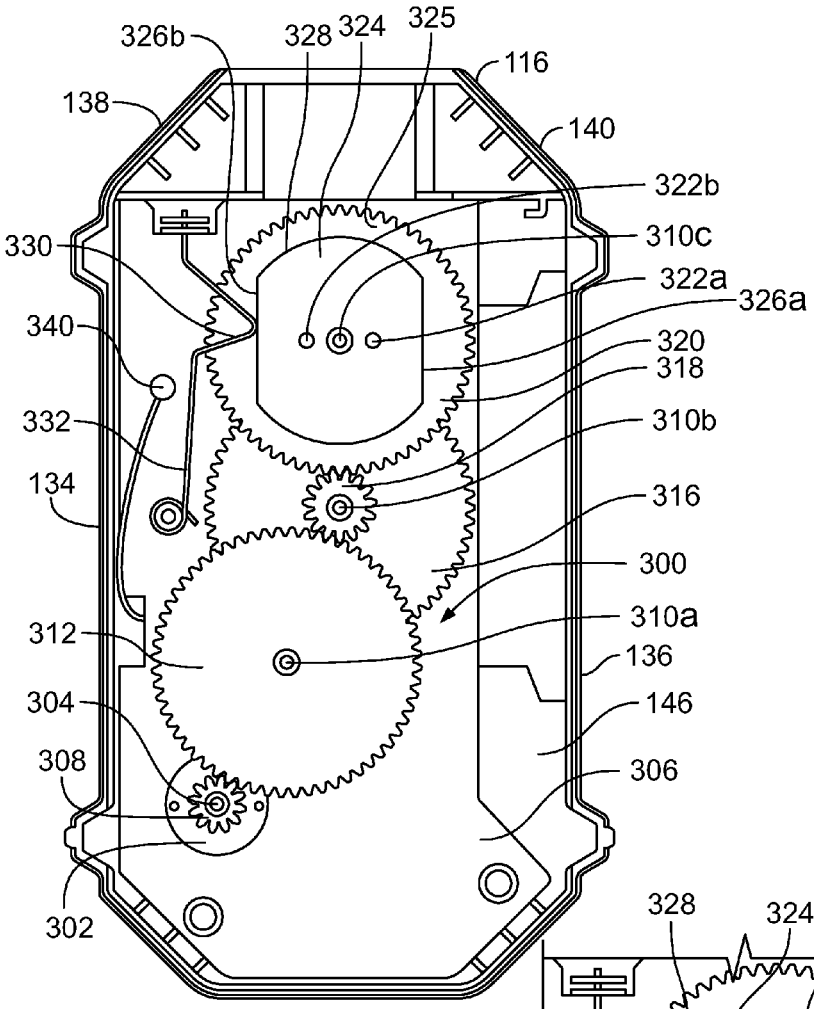
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FIG. 17

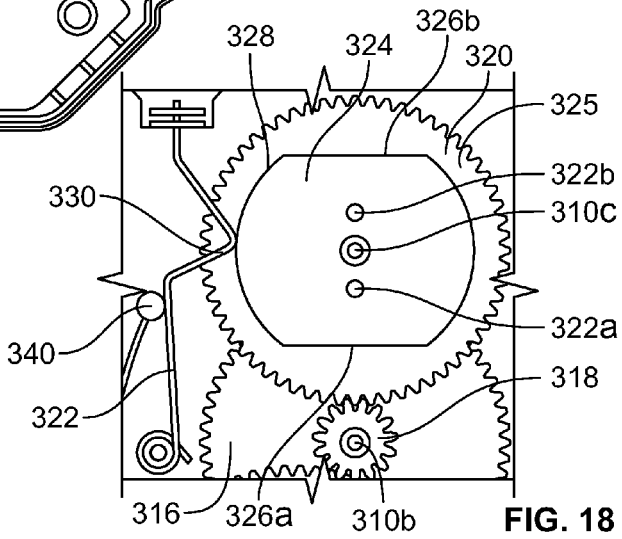
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FIG. 18

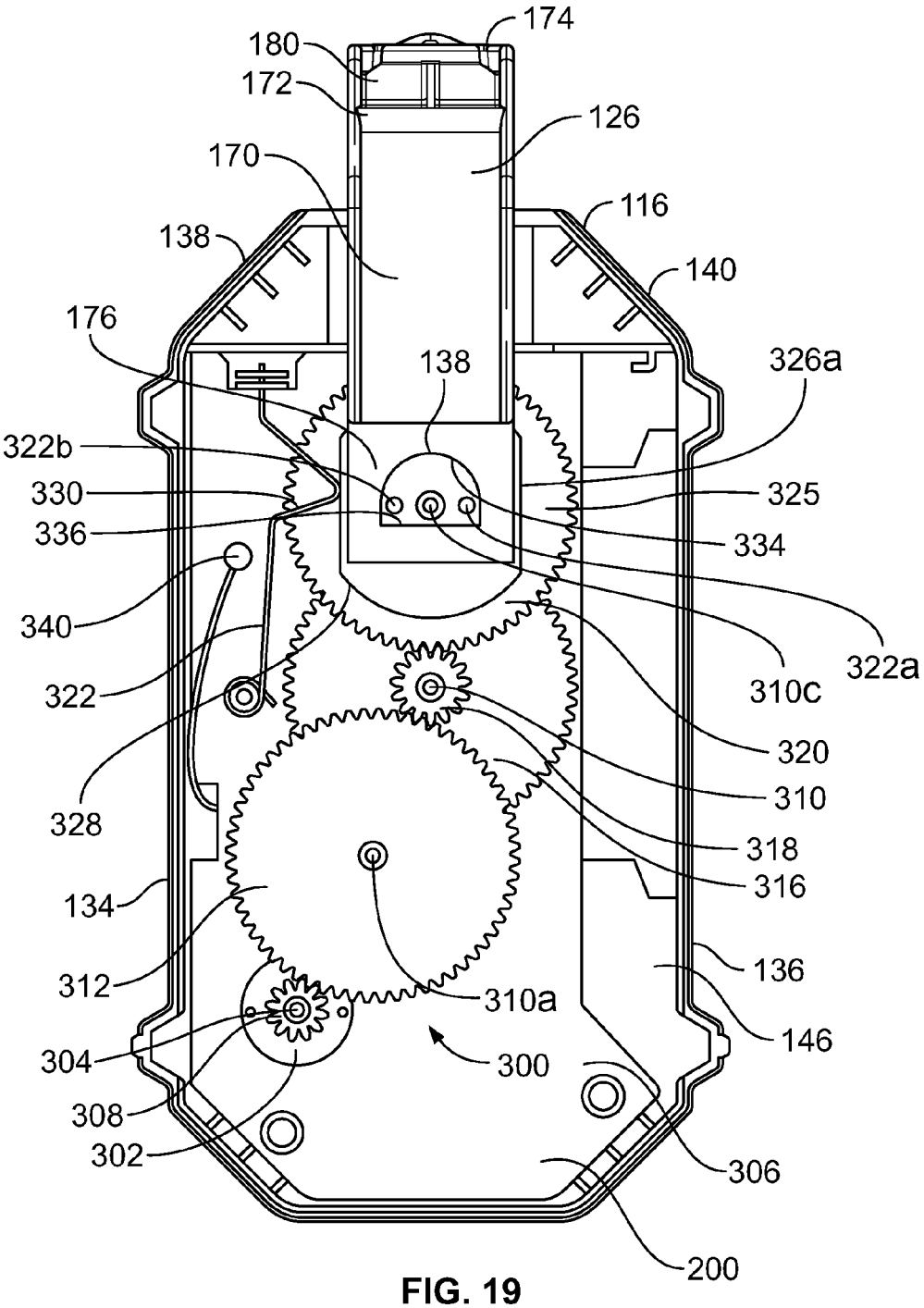
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FIG. 19

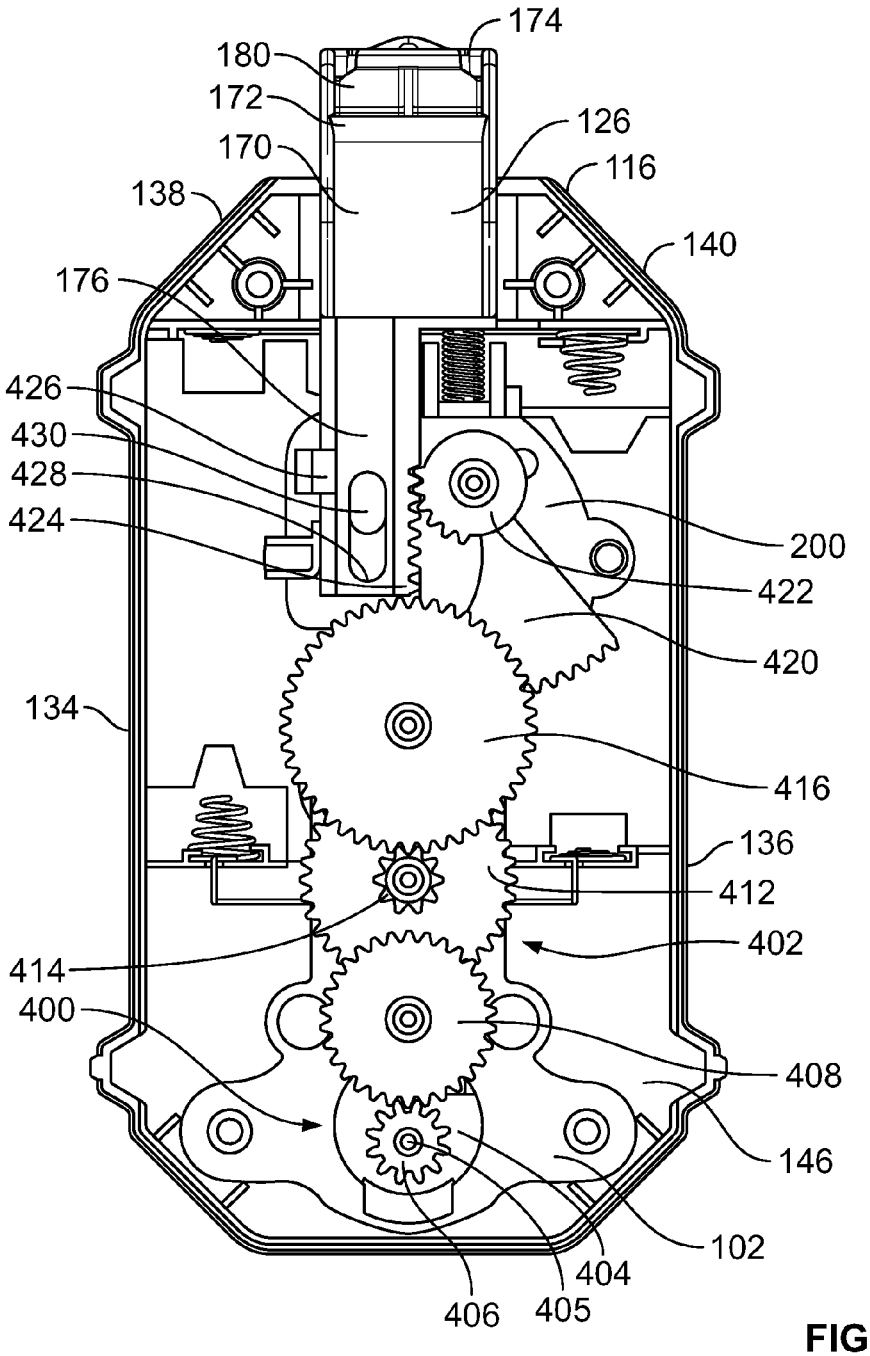
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FIG. 20

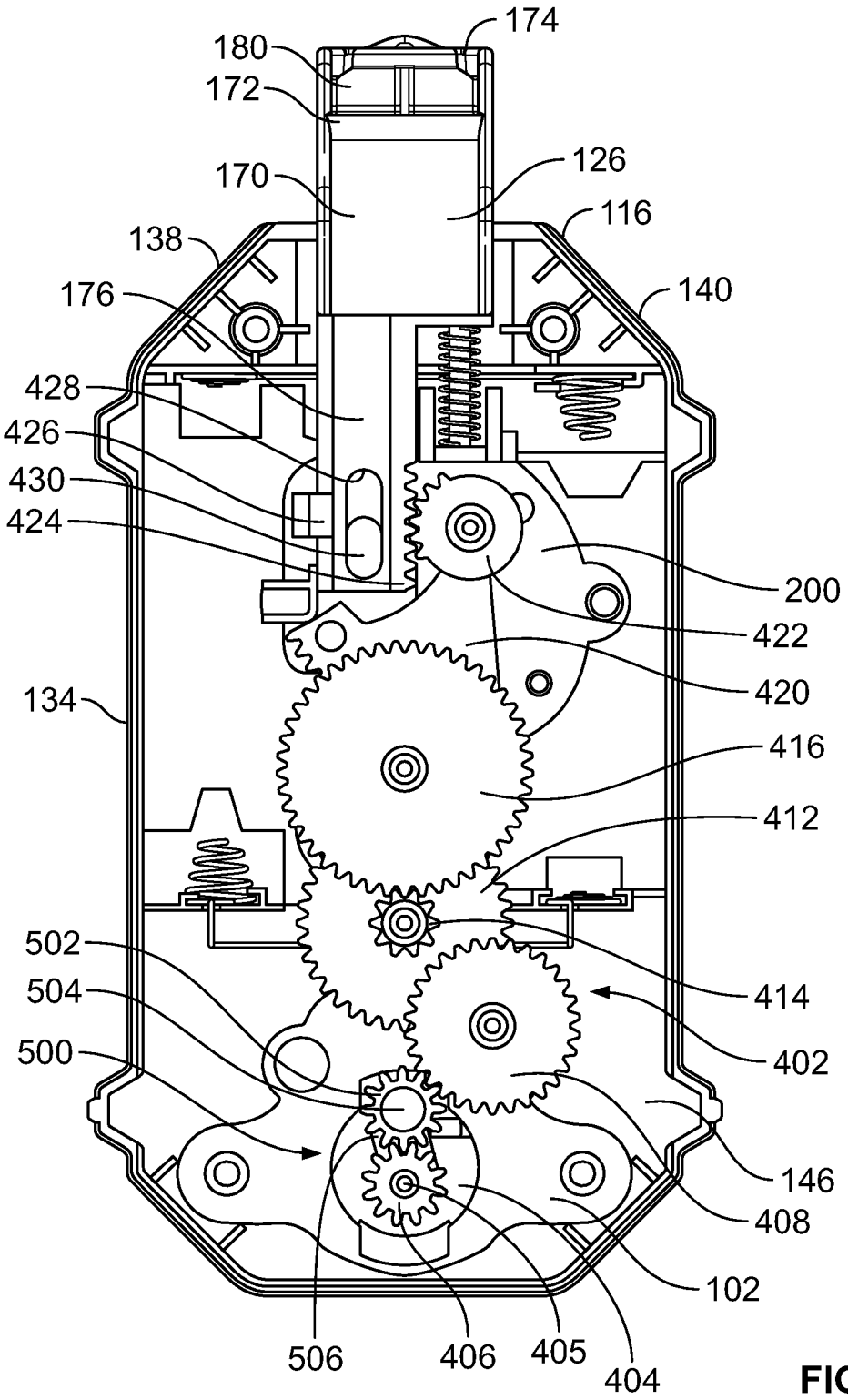
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FIG. 21

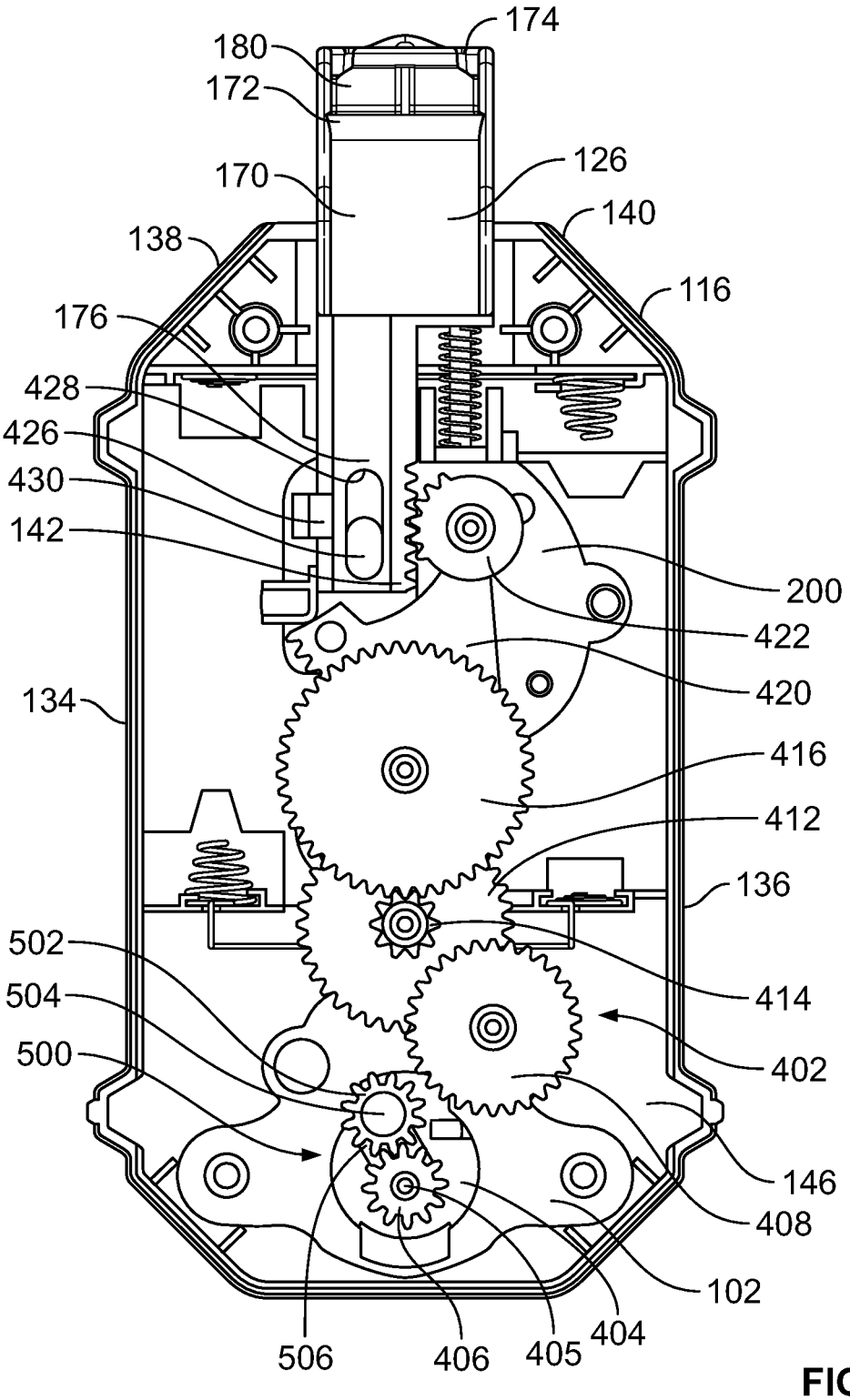
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FIG. 22

DISPENSER WITH MOTOR, GEAR PLATE, AND SNAP FIT CAP

CROSS REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Application No. 61/448,108 filed on Mar. 1, 2011.

REFERENCE REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

Not applicable

SEQUENTIAL LISTING

Not applicable

BACKGROUND OF THE INVENTION

1. Field of the Background

The present disclosure relates to drive module assemblies for use in dispensers that discharge volatile materials from an aerosol container and method of making same.

2. Description of the Background

A drive module assembly for discharging a fluid from an aerosol container within a dispenser is typically assembled piece-by-piece directly into the housing of the dispenser. The drive module assemblies are not inserted into the dispenser as a whole assembled unit and cannot be removed as a single unit. Additionally, components of the drive module assemblies are traditionally attached together by way of screws, bolts, or other similar fasteners.

Thompson et al. U.S. Pat. No. 7,011,795 discloses a device for dispersing scented materials into an environment. The device includes a drive assembly mounted within a bottom housing of the device and includes a motor and gear train. The pieces of the drive assembly, i.e. the motor and the gears are separately inserted into the housing of the device. Additionally, the motor is mounted directly to the housing by a motor retainer, which appears to include a hole for a fastener such as a screw to secure the motor in the housing.

These prior devices fail to provide drive assemblies that are easy and labor efficient to manufacture and assemble. Additionally, the prior art devices fail to provide drive module assemblies that are assembled as a whole before being singularly inserted into a dispenser, providing manufacturers with less ability to change the design of the dispensers without having to redesign the drive assembly.

SUMMARY OF THE INVENTION

According to one embodiment, a drive module assembly includes a drive motor and a gear plate with a seat for retaining the motor. The assembly also includes a motor cap having at least one pawl for snap-fitting into the seat. The assembly further includes at least one axle, which is adapted to receive a gear.

According to another embodiment, a method for assembling a drive module includes the step of providing a gear plate with a seat for a motor and at least one axle. Further, the method includes the steps of retaining the motor within the seat, providing a motor cap with at least one pawl, wherein the at least one pawl snaps into the seat, and disposing a gear train on the at least one axle.

According to a different embodiment, a dispensing system includes a housing, a container having a product therein, and a drive module assembly adapted to release product from the dispensing system. The drive module assembly includes a drive motor and a gear plate with a seat for retaining the motor. The drive module assembly also includes a motor cap having two pawls disposed on a bottom side for snap-fitting into the seat, and two pawls extending from an upper surface thereof. The drive module assembly further includes at least one axle adapted to receive a gear.

Other aspects and advantages will become apparent upon consideration of the following detailed description and the attached drawings, in which like elements are assigned like reference numerals.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an isometric view of a first embodiment of a drive module assembly including a gear plate, a motor, a motor cap, a printed circuit board assembly, and a gear train;

FIG. **2** is an isometric view of the drive module assembly of FIG. **1**;

FIG. **3** is an exploded isometric view of the drive module assembly of FIG. **1** wherein the gear train is omitted;

FIG. **4** is an isometric view of the front, bottom, and left side of the motor of FIG. **1**;

FIG. **5** is a front elevational view of a dispenser, which uses the drive module assembly of FIG. **1**;

FIG. **6** is a front elevational view of the dispenser of FIG. **5** wherein a cover has been omitted for clarity;

FIG. **7** is a rear elevational view of the cover;

FIG. **8** is a rear elevational view of the dispenser of FIG. **5**;

FIG. **9** is an isometric view of the front, top, and left side of the dispenser of FIG. **5** wherein a cover, batteries, and container have been removed for clarity;

FIG. **10** is a rear elevational view of the dispenser of FIG. **5** wherein a rear panel has been removed;

FIG. **11** is an isometric view of the dispenser of FIG. **10** wherein the rear panel has been removed for clarity;

FIG. **12** is a front elevational view of the rear panel and actuator arm of the dispenser of FIG. **5**;

FIG. **13** is a front elevational view of the rear panel of the dispenser of FIG. **5** including the actuator arm and gear train;

FIG. **14** is an isometric view of a second embodiment of a drive module assembly including a gear plate, a motor, and a printed circuit board, wherein a gear train is omitted for purposes of clarity;

FIG. **15** is an isometric view of the drive module assembly of FIG. **14**, wherein the motor and printed circuit board are omitted for purposes of clarity;

FIG. **16** is an isometric view of a third embodiment of a drive module assembly including a gear plate, a motor, and a printed circuit board, wherein a gear train is similarly omitted for purposes of clarity;

FIG. **17** is a rear elevational view of a fourth embodiment of a drive module assembly disposed in a dispenser;

FIG. **18** is a partial rear elevational view of the drive module assembly of FIG. **17**, with a switch in a closed position;

FIG. **19** is a view similar to FIG. **17**, except that an actuator arm has been included;

FIG. **20** is a rear elevational view of a fifth embodiment for a drive module assembly disposed in a dispenser;

FIG. **21** is a rear elevation view of a sixth embodiment for a drive module assembly disposed in a dispenser; and

FIG. **22** is a view similar to FIG. **21**, except the drive module assembly is in a disengaged position.

DETAILED DESCRIPTION OF THE DRAWINGS

FIGS. **1-4** depict a first embodiment of a drive module assembly **100**. The drive module assembly **100** generally

includes an integral gear plate **102**, a snap-in motor **104**, a motor cap **106**, a printed circuit board assembly ("PCBA") **108**, and a gear train **109**. The drive module assembly **100** is designed to be utilized in a dispenser **110** (shown in FIGS. **5-13**) for dispensing the contents of a container **112**. The container **112** may be an aerosol container or a pump-type sprayer of any size and volume known to those skilled in the art. However, the container **112** is preferably an aerosol container having a valve assembly (not shown), which includes a valve stem **114**. The dispenser **110** may be one of the devices described in Carpenter et al. U.S. patent application Ser. No. 11/725,402, which is incorporated herein by reference in its entirety.

Still referring to FIGS. **5-13**, the dispenser **110** generally includes a housing **116** that is adapted to receive the drive module assembly **100**, the aerosol container **112**, and batteries **118**. In addition, the dispenser **110** includes a sensor **120**, one or more input devices **122** (shown in FIG. **1**) such as switches, dials, keypads, pushbuttons, etc., a light source **124**, e.g., a light emitting diode ("LED"), an actuator arm **126**, and a housing cover **128**. The sensor **120** in the present embodiment is a photocell light sensor, which may be used to detect motion. However, any other type of motion detector may be utilized, e.g., a passive infrared or pyroelectric motion sensor, an infrared reflective motion sensor, an ultrasonic motion sensor, or a radio or microwave radio motion sensor. Further, the sensor **120** can be replaced or used in combination with any other type of sensor known to those skilled in the art, e.g., a heat sensor or an odor sensor.

Turning to FIG. **6**, the housing **116** of the dispenser **110** comprises a base portion **130** and a top portion **132**. First and second sidewalls **134**, **136**, respectively, extend between the base portion **130** and the top portion **132**. Further, the top portion **132** includes first and second shoulders **138**, **140**, respectively, wherein the first shoulder **138** extends inwardly from the first sidewall **134** and the second shoulder **140** extends inwardly from the second sidewall **136**. The present embodiment also includes an actuator arm cover **142** that extends upwardly from the top portion **132** to cover the actuator arm **126**, however, the actuator arm cover **142** could be omitted. In a preferred embodiment, the actuator arm cover **142** is contoured to have a shape similar to that of the actuator arm **126**. The top portion **132** also includes a channel **144**, wherein the channel **144** is disposed between an inner rear panel **146** (see FIG. **10**) and an outer rear panel **148** of the housing **116** (see FIG. **12**).

Referring now to FIGS. **5**, **7**, and **8**, the housing cover **128** is pivotally attached to the housing **116** by a hinge **150**. The cover **128** wraps around the side walls **134**, **136**, the top portion **132**, the actuator arm **126**, and a front side **152** of the housing **116** in a closed condition, thereby leaving a bottom end **131** of the base portion **130** and the rear side **154** of the housing **116** exposed. The cover **128** is moved to an open position by rotating same about the hinge **150**. The cover **128** may include a plurality of posts **156** extending from an inner surface **157** thereof, for retaining the batteries **118** and/or the container **112** when the cover **128** is closed. The cover **128** also includes a generally teardrop shaped orifice **158** provided in a lower end **160** thereof. A similarly shaped button **162** extends through the orifice **158** and projects outwardly from the cover **128**. The button **162** includes a top surface **164** for engagement by a user's thumb or finger. A curved orifice **166** is disposed within the top surface **164** of the button **162**. The orifice **166** is aligned with the sensor **120** disposed within the base portion **130** of the housing **116**. The button **162** is provided for activating the dispenser **110** to emit fluid upon the depression of same. The button **162** is attached to the front side **152** of the housing **116** by way of a living hinge **168** (see FIG. **6**), wherein the depression and/or rotation of the button **162** about the living hinge **168** causes a switch **122** (shown in FIG. **1**) to generate a signal and the dispenser **110** to discharge fluid during manual activation. The button **162** is made of a material, which allows the LED **124** to be viewable through the button **162**. In other embodiments it is contemplated that the cover **128** may be adapted to include an LED port through which to view the LED **124**.

With regards to FIGS. **9-11**, the actuator arm **126** includes a main portion **170**, an intermediate portion **172**, and an overhang portion **174**. A depending attachment portion **176** that includes a circular aperture **178** extends downwardly from the main portion **170**. The attachment portion **176** is coupled to a section of the drive module assembly **100**, as noted in greater detail hereinafter. The main portion **170** is disposed within the channel **144** and is substantially parallel with the outer rear panel **148** of the housing **116**. The intermediate portion **172** of the actuator arm **126** extends laterally and upwardly from the main portion **170**. An upper end **180** of the intermediate portion **172** is therefore farther from the outer rear panel **148** and the top portion **132** of the housing **116** than the main portion **170**. The overhang portion **174** of the actuator arm **126** extends from the upper end **180** of the intermediate portion **172** toward the front side **152** of the housing **116**. The overhang portion **174** is substantially transverse to the main portion **170**.

Prior to opening the valve assembly and releasing the contents of the container **112**, the overhang portion **174** of the actuator arm **126** is positioned in a pre-actuation position (see FIG. **6**). Preferably, when the actuator arm **126** and the overhang portion **174** are positioned in a pre-actuation position, a distal end of the valve stem **114** is spaced slightly from or just in contact with a lower side **182** of the overhang portion **174**. Alternatively, at this point, the overhang portion **174** may partially depress the valve stem **114** a distance insufficient to open the valve stem **114**. The actuator arm **126** depresses the valve stem **114** through motion imparted thereto by the module drive assembly **100** as described below.

The dispenser **110** discharges fluid from the container **112** upon occurrence of a particular condition. The condition could be the manual activation of the dispenser **110** or the automatic activation of the dispenser **110** in response to an elapsed time interval or signal from the sensor **120**. The fluid may be a fragrance or insecticide disposed within a carrier liquid, a deodorizing liquid, or the like. For example, the fluid may comprise OUST®, an air and carpet sanitizer for household, commercial, and institutional use, or GLADE®, a household deodorant, both sold by S. C. Johnson and Son, Inc., of Racine, Wis. The fluid may also comprise other actives, such as sanitizers, air fresheners, odor eliminators, mold or mildew inhibitors, insect repellents, and the like, or that have aromatherapeutic properties. The fluid alternatively comprises any fluid known to those skilled in the art that can be dispensed from a container. The dispenser **110** is therefore adapted to dispense any number of different fluid formulations.

Referring again to FIGS. **1-4**, the various components of the drive module assembly **100** will be described. The gear plate **102** includes a seat **184** located at a first end **186** thereof. The seat **184** includes two opposing curved support members **188***a*, **188***b* extending upwardly from an upper surface **189** of the gear plate **102**. A circular aperture **190** is disposed in the gear plate **102** between the curved support walls **188***a*, **188***b*. Additionally, two pins **192** (only one pin is shown) extend upwardly from the seat **184** of the integral gear plate **102**. An elongate section **194** of the gear plate **102** extends from the

seat **184** to a second end **196** of the integral gear plate **102**. A plurality of axles **198***a*, **198***b*, **198***c* extend from an underside **200** of the gear plate **102**. The axles **198***a-c* are designed to receive a plurality of gears of the gear train **109** for driving the dispenser **110**. In this embodiment, there are three axles, but any number of axles may be used in conjunction with any gear train capable of driving the dispenser **110**.

As shown in FIGS. **3** and **4**, the motor **104** includes a drive shaft **204** extending from a front side **206**, thereof. The motor **104** also includes two holes **208** disposed in the front side **206** of the motor **104**. The holes **208** are designed to receive the pins **192** located on the gear plate **102**.

Still referring to FIG. **3**, the motor cap **106** includes a horizontal platform **210** with two opposing arms **212***a*, **212***b* depending from a bottom **214** of the platform **210**. The depending arms **212***a*, **212***b* include snap-in pawls **216***a*, **216***b* disposed on outer surfaces **218***a*, **218***b* of the arms **212***a*, **212***b*, respectively. Leader guide surfaces **220***a*, **220***b* are disposed on distal ends of the depending arms **212***a*, **212***b*, respectively. The motor cap **106** also includes two guide posts **222** extending upwardly from an upper surface **224** of the horizontal platform **210**. Two axial restraining surfaces **226** are disposed adjacent the guide posts **222** on the horizontal platform **210**. Additionally, two opposing PCBA supports **228***a*, **228***b* extend upwardly from the upper surface **224** of the horizontal platform **210**. The PCBA supports **228***a*, **228***b* include snap-in pawls **230***a*, **230***b* disposed on inner surfaces **232***a*, **232***b* (only **232***b* is shown, **232***a* being a mirror image thereof) of the PCBA supports **228***a*, **228***b*, respectively.

Referring now to FIGS. **1-3**, the PCBA **108** includes a board **234** with the actuation switch **122**, the LED **124**, and the sensor **120** disposed on an upper surface **236** of the board **234**. The PCBA **108** further includes two holes **238** provided in the board **234**.

In an assembled position, the motor **104** is disposed between the curved support members **188***a*, **188***b* on the seat **184** of the integral gear plate **102**. The drive shaft **204** of the motor **104** extends through the circular aperture **190** in the seat **184** when the motor **204** is seated on the integral gear plate **102**. The holes **208** in the front side **206** of the motor **104** receive the two pins **192** located on the integral gear plate **102**. The holes **208** and pins **192** are designed to torsionally restrain the motor **104** within the gear plate **102**, to prevent the motor **104** from rotating during operation. After the motor **104** is disposed within the seat **184**, the motor cap **106** is inserted over the motor **104**, thereby locking the motor **104** in place within the seat **184** of the integral gear plate **102** without the need for screws. The leader guide surfaces **220***a*, **220***b* align the depending arms **212***a*, **212***b* of the motor cap **106** with the supports **188***a*, **188***b*, respectively, on the integral gear plate **102**. When the arms **212***a*, **212***b* and supports **188***a*, **188***b* are properly aligned, the pawls **216***a*, **216***b* are able to snap into snap-fit engagement portions **240***a*, **240***b* located on the supports **188***a*, **188***b*, respectively. The pawls **216***a*, **216***b* retain the motor cap **106** over the motor **104**, thereby locking the motor **104** in place on the integral gear plate **102**. Although this embodiment uses snap in pawls **216***a*, **216***b* to attach the motor cap **106** to the integral gear plate **102**, it is contemplated that other snapping engagement mechanisms may be used to attach the motor cap **106** to the gear plate **102** to restrain the motor **104** without screws.

When the motor cap **106** is attached to the integral gear plate **102** the PCBA **108** is aligned and attached to the upper surface **224** of the motor cap **106**. The holes **238** in the board **234** align and receive the guide posts **222** of the motor cap **106**. The guide posts **222** ensure that the LED **124**, the sensor **120**, and the switch **122** located on the board **234** properly align with the housing **116** of the dispenser **110**, when the drive module assembly **100** is inserted into the dispenser **110**. As the PCBA **108** is inserted onto the motor cap **106**, the PCBA supports **228***a*, **228***b* deflect outwardly to allow the PCBA **108** to pass by the pawls **230***a*, **230***b* and sit on the axial retaining surfaces **226** of the motor cap **106**. After the PCBA **108** passes the pawls **230***a*, **230***b*, the supports **228***a*, **228***b* snap back into place and the pawls **230***a*, **230***b* rest above the board **234** and lock the PCBA **108** onto the motor cap **106**.

Turning to FIGS. **14** and **15**, another embodiment of a drive module assembly **100'** is depicted, which is identical to the previously described embodiment except for the below noted differences. One particular difference is that in this embodiment the drive module assembly **100'** may be assembled without the motor cap **106**. As shown in FIGS. **14** and **15**, the seat **184** of the gear plate **102** includes two curved support members **268***a*, **268***b* extending from the upper surface **189** of the gear plate **102**. The support members **268***a*, **268***b* of the present embodiment are disposed generally opposite one another about the seat **184**. Further, the support members **268***a*, **268***b* are substantially triangular in shape and each taper inwardly to an upper end thereof, which include pawls **269***a*, **269***b*. Still further, while the present support members **268***a*, **268***b* are generally uninterrupted, other embodiments could include apertures or cutaway portions therein.

Two PCBA supports **270***a*, **270***b* also extend upwardly from the upper surface **189** of the gear plate **102**. The PCBA supports **270***a*, **270***b* of the present embodiment are substantially cylindrical in shape. However, in other embodiments, different geometric shapes are utilized, e.g., rectangular or triangular. The PCBA supports **270***a*, **270***b* include pawls **272***a*, **272***b*, and guide posts **274***a*, **274***b* extending from upper surfaces of the PCBA supports **270***a*, **270***b*, respectfully.

To assemble the drive module assembly **100'**, the motor **104** is pressed within the curved support members **268***a*, **268***b*, thereby causing the curved support members **268***a*, **268***b* to flex outwardly and for the motor **104** to be seated therein. The motor **104** of the present embodiment includes grooves **276***a*, **276***b* (only **276***a* is shown), which are aligned with the pawls **269***a*, **269***b*, on the upper ends of the support members **268***a*, **268***b*. The grooves **276***a*, **276***b* may comprise any shape and may be provided in numbers greater than two about the base of the motor **104** to allow for ease of assembly. In an assembled position the motor **104** is disposed between the curved support members **268***a*, **268***b* on the seat **184** of the gear plate **102** and the pawls **269***a*, **269***b* snap into the corresponding grooves **276***a*, **276***b* of the motor **104** to hold it in place. The drive shaft **204** of the motor **104** extends through the gear plate **102** in a similar manner as discussed above. It is anticipated that the pins **192** on the gear plate **102** and the holes **208** on the motor **104** as previously described may be omitted (but it is not necessary to do so) as the pawls **269***a*, **269***b* and curved support members **268***a*, **268***b* are adapted to prevent torsional motion of the motor **104**.

After the motor **104** is disposed within the seat **184**, the PCBA **108** is then attached to the assembly **100'**. The holes **238** in the board **234** align with and receive the guide posts **274***a*, **274***b* of the PCBA supports **270***a*, **270***b*, respectively. When the board **234** is in position, a bottom side thereof rests on two axial restraining surfaces **278***a*, **278***b* disposed adjacent guide posts **274***a*, **274***b*, respectfully, to support the board **234**. Further, the pawls **272***a*, **272***b* snap over the board **234** to lock the PCBA **108** in place. A post **280** is also provided that extends from the upper surface **189** of the gear plate **102** to contact the bottom side of the board **234** to provide additional support to the PCBA **108**.

Other modifications can be made to the drive module assembly **100'** without departing from the spirit of the present disclosure. For example, as shown in FIG. **16**, the PCBA **108** may be attached directly to the motor **104** using welding, adhesives, or other techniques known in the art, prior to attaching the motor **104** to the assembly **100'**. The motor **104** and PCBA **108** may then be attached to the assembly **100'** as a single unit without the need for PCBA supports (see FIG. **16**). As described above, motor support members **268***a*, **268***b* snap over the motor **104** to hold the motor **104** and PCBA **108** within the drive module assembly **100'**. Further, the seat **184** may include a shroud **282**, which fully or partially surrounds the motor **104** to provide additional support when the motor is attached to the assembly **100'**. Still further, as shown in FIG. **16**, the motor **104** may include motor terminals **284***a*, **284***b* and a post **286**, which extend from an upper surface thereof and through holes **288** provided in the PCBA **108** to help align and/or retain the PCBA **108** on the motor **104**.

Referring now to FIG. **2**, a first pinion gear **242** is disposed on the drive shaft **204** of the motor **104**, which extends through the integral gear plate **102**. The first pinion gear **242** meshes with a first large gear **244**, wherein the first large gear **244** includes a second pinion gear **246**. The first large gear **244** and second pinion gear **246** are disposed on the axle **198***a* and are both rotatable about same. The second pinion gear **246** meshes with a second large gear **248**, wherein the second large gear **248** include a third pinion gear **250** (shown in FIG. **13**) and both the second large gear **248** and the third pinion gear **250** are disposed on and rotatable around the axle **198***b*. The third pinion gear **250** meshes with a sector gear **252** that is disposed on and rotatable around the axle **198***c*.

After assembly, the gear plate **102**, the motor **104**, the motor cap **106**, the PCBA **108**, and the gear train **109**, i.e., the drive module assembly **100**, can be singularly inserted into the dispenser **110** (see FIGS. **10** and **11**). The drive module assembly **100** is disposed between the inner rear panel **146** and the outer rear panel **148** of the housing **126**. Distal ends of the axles **198***a*, **198***b*, **198***c* extend into holes **254***a*, **254***b*, **254***c* (shown in FIG. **12**), respectively, provided on an inner surface **256** of the outer rear panel **148**. The drive module assembly **100** may be attached to the dispenser **110** by screws or other attachment means known in the art. Being able to singularly insert the assembled drive module assembly **100** into the device makes the device easier to manufacture and more labor efficient to assemble than if the drive module components were inserted piece-by-piece into the dispenser. The drive module assembly **100** may also be manufactured as a single unit and then singularly inserted into a variety of different dispensers. This is beneficial because it allows a manufacturer to offer a consumer a variety of different dispensers without having to redesign the entire drive module. Additionally, the snap-in engagement features of the individual components creates a more labor efficient assembly of the drive module than drive modules with components that must be screwed together. Further, having the axles **198***a-c* extend from a singular gear plate **102** allows for better alignment of the gears. The ability to have greater control over alignment of the gears allows for closer tolerances between the gears comprising the gear train **109**, thereby providing the benefit of reduced noise during operation of the dispenser.

Still referring to FIGS. **10** and **11**, the actuation of this embodiment of the drive module assembly **100** of the dispenser **110** will be described. Activation of the dispenser **110** may be initiated by manual input, i.e., a user pressing the pushbutton **162**, sensory input, and/or the lapsing of a time interval. When the dispenser **110** is activated, the drive shaft **204** of the motor **104** is driven in a clockwise direction. Clockwise rotation of the draft shaft **204** causes the first pinion gear **242** to similarly rotate in a clockwise direction. The first pinion gear **242** meshes with and drives the first large gear **244** and the second pinion gear **246** in a counter-clockwise direction. The second pinion gear **246** drives the second large gear **248** and the attached third pinion gear **250** (shown in FIG. **13**) in a clockwise direction. The third pinion gear **250** meshes with the sector gear **252** causing the sector gear **252** to rotate in a counter-clockwise direction.

With reference to FIGS. **10** and **11**, a rod **258** extends from an upper end **260** of the sector gear **252**. The rod **258** is provided within the circular aperture **178** of the attachment portion **176** of the actuator arm **126**. As the sector gear **252** rotates in a counter-clockwise direction, the rod **258** is rotated in a downward direction. As the rod **258** rotates it impinges on portions of the actuator arm **126** defining the circular aperture **178**, thereby similarly pulling the actuator arm **126** downwardly. Downward movement of the actuator arm **126** causes the overhang portion **174** thereof to depress the valve stem **114** of the aerosol container **112**, which causes the subsequent release of fluid from the container **112**. The fluid is thereafter emitted through a dispensing bore **262** provided within the overhang portion **174** of the actuator arm **126** and into the atmosphere. The downward path of the actuator arm **126** has a direction that is parallel to a longitudinal axis **264** of the container **112**. Two posts **266**, which project from the gear plate **102**, interfere with the sector gear **252** to prevent the sector gear **252** from pulling the actuator arm **126** too far down on the valve stem **114**. The length of time the actuator arm **126** is held in the discharge position is the spraying period. The duration of the spraying period could range anywhere from a fraction of a second to one or more seconds depending on the amount of fluid that is desired to be released from the container **112**. Indeed, if desired, the actuator arm **126** could be held in the discharge position until all of the container contents are exhausted. It is also contemplated that the container **112** could have a metered valve stem, which releases a specific amount of fluid independent of the duration of time the actuator arm **126** is held in the discharge position.

Upon completion of a spraying sequence, the motor **104** is energized in a second direction to reverse the direction of rotation of the drive shaft **204**. The rotation of the drive shaft **204** in the counter-clockwise direction causes the above-noted gears to similarly rotate in an opposite direction causing the rod **258** of the sector gear **252** to rotate in an upward direction. The upward motion of the rod **258** forces the actuator arm **126** upwardly, thereby allowing the valve stem **114** of the container **112** to return to a pre-actuated position due to the upward force provided by the valve assembly, at which time the valve assembly is closed and terminates further spraying.

FIGS. **17-19** show an alternative embodiment of a drive module assembly **300** designed to use a unidirectional motor **302**. A drive shaft **304** of the unidirectional motor **302** extends through a modified integral gear plate **306** and has a first pinion gear **308** thereon. A first axle **310***a* on the integral gear plate **306** receives a first large gear **312** and a second pinion gear (not shown). A second axle **310***b* receives a second large gear **316** and a third pinion gear **318** and a third axle **310***c* receives a cam gear **320**. The cam gear **320** includes a rimmed portion **324** disposed on an upper surface **325** thereof. A first and a second pin **322***a*, **322***b*, respectively, are disposed on the rimmed portion **324** on opposing sides of the third axle **310***c*. The rimmed portion **324** also includes two detents **326***a*, **326***b* on an outer surface **328** thereof. A bent section **330** of a spring **332**, which is disposed on the integral gear plate **306**, rides along the outer surface **328** of the rimmed portion **324** of the

cam gear **320**. The actuator arm **126** in the present embodiment includes a u-shaped cutout cam section **334** disposed in the attachment portion **176** thereof. The u-shaped cutout cam section **334** includes a flat side **336** and a rounded section **338**. The u-shaped cutout cam section **334** is designed to receive the two pins **322***a*, **322***b* when the actuator arm **126** is inserted into the housing **116**.

When the motor **302** is initially activated either by the manual pushbutton **162**, the sensor **120**, and/or the lapsing of a time interval, the drive shaft **304** and the first pinion gear **308** are rotated in a clockwise direction. The first pinion gear **308** meshes with the first large gear **312** causing the first large gear **312** and the attached second pinion gear (not shown) to rotate in a counter-clockwise direction. The second pinion gear meshes with the second large gear **316** and the attached third pinion gear **318** to cause the second large gear **316** and the third pinion gear **318** to rotate in a clockwise direction. The third pinion gear meshes with the cam gear **320**, thereby causing the cam gear **320** to rotate in a counter-clockwise direction. As the cam gear **320** rotates, the pins **322***a*, **322***b* revolve around the axle **310***c* in a counter-clockwise direction. As the pins **322***a*, **322***b* move, the first pin **322***a* contacts the flat side **336** of the cutout cam section **334** of the actuator arm **126**. The pin **322***a* pushes down on the flat side **336** of the cutout cam section **334**, thereby causing the actuator arm **126** to move downwardly and depress the valve stem **114** of the container **112** in the same manner as described above. As the first pin **322***a* is pushing on the flat side **336** the second pin **322***b* is able to revolve within the rounded section **338** of the cutout cam section **334**. As the pins **322***a*, **322***b* continue to revolve, the first pin **322***a* passes the flat side **336** of the cutout cam section **334**. When the downward force is removed from the actuator arm **126**, the actuator arm **126** and the valve stem **114** then move upwardly to the pre-actuation position in response to the upward force provided by the valve assembly, at which time the valve assembly of the container **112** is closed.

The initial activation of the motor **302** by either the manual pushbutton **162**, the sensor **120**, and/or the lapsing of a time interval, rotates the cam gear **300** to cause the bent section **330** of the spring **332** to move out of the detent **326***b* and ride along the outer surface **328** of the rimmed portion **324**, thereby causing the spring **332** to contact and activate a spring switch **340** disposed on the gear plate **306** (see FIG. **18**). The motor **302** continues to run until the bent section **330** of the spring **332** rides into the second detent **326***a*, thereby causing the spring **332** to move off of the spring switch **340**. When the spring switch **340** is opened the motor **302** is turned off. The pins **322***a*, **322***b* are positioned on the cam gear **320** such that when the spring **332** enters one of the detents **326***a*, **326***b* to turn the motor **302** off, the actuator arm **126** is in the pre-actuation position. Although the preferred embodiment describes the cutout cam section **334** as u-shaped, it is contemplated that the cutout cam section **334** could be any shape that would allow the pins to contact a side of the cutout to pull the actuator arm in a downward direction.

In a further embodiment, illustrated in FIG. **20**, a drive module assembly **400** is adapted to have a gear train **402** with a higher gear ratio, which allows the drive module assembly **400** to use a smaller and more efficient motor **404**. The gear train **402** includes a first pinion gear **406** attached to a drive shaft **405** of the motor **404**, a first large gear **408** and attached second pinion gear (not shown), a second large gear **412** and attached third pinion gear **414**, a third large gear **416** and attached fourth pinion gear (not shown), and a sector gear **420** and attached fifth pinion gear **422**. The fifth pinion gear **422** meshes with a rack **424** disposed on the attachment portion **176** of the actuator arm **126**. The gear plate **102** is adapted to include a capture pawl **426** extending from the underside **200** of the gear plate **102**. The actuator arm **126** is constrained on the gear plate **102** by the capture pawl **426**, which allows the actuator arm **126** to become part of the module drive assembly **400**, thereby providing easy module assembly. A racetrack-shaped slot **428** is provided in the attachment portion **176** of the actuator arm **126**. The racetrack-shaped slot **428** receives a racetrack-shaped rod **430** disposed on the underside **200** of the gear plate **102**. The rod **430** constrains the movement of the actuator arm **126** in the longitudinal direction. Additionally, a spring **432** is provided below the actuator arm **126** to assist the valve assembly of the container **112** in overcoming the higher tare torque of the gear train **402** to raise the actuator arm **126** to a pre-actuation position when the motor **404** is deactivated.

During activation, the motor **404** drives the first pinion gear **406** in a counter-clockwise direction causing the first large gear **408** and the attached second pinion gear to rotate in a clockwise direction. The second pinion gear causes the second large gear **412** and the attached third pinion gear **414** to rotate in a counter-clockwise direction. The third pinion gear **414** rotates the third large gear **416** and the attached fourth pinion gear in a clockwise direction, which causes the sector gear **420** and the attached fifth pinion gear **422** to rotate in a counter-clockwise direction. The rotation of the fifth pinion gear **422** in the counter-clockwise direction causes the rack **424** on the attachment portion **176**, and ultimately the actuator arm **126**, to be pulled downwardly, thereby releasing fluid from the aerosol container **112** as described above.

Referring now to FIGS. **21** and **22**, another embodiment of a drive module assembly **500** is illustrated, which is also adapted to have a gear train **402** with a higher gear ratio to allow the assembly **500** to use a smaller and more efficient motor **404**. This embodiment **500** is similar to and operates in substantially the same way as the third embodiment **400** except for the below noted differences, wherein like components are given like reference numerals. One particular difference is the provision of an idler gear **502** between the first pinion gear **406** and the first large gear **408** of the gear train **402**. The idler gear **502** is attached to an axle **504** connected to one end of a swing arm **506**. A second end of the swing arm **506** is attached to the drive shaft **405**. The swing arm **506** allows the idler gear **502** to pivot around the drive shaft **405** and the first pinion gear **406**. Upon activation of the motor **404**, the drive shaft **405** and the first pinion gear **406** are rotated in a clockwise direction causing the swing arm **506** to also rotate in a clockwise direction. The clockwise rotation of the swing arm **506** pivots the idler gear **502** into engagement with the first large gear **408** to cause the first large gear **408** to rotate in the clockwise direction (shown in FIG. **21**). The gear train **402** transmits the rotation in a similar manner as noted above to cause the actuator arm **126** to be pulled downwardly, thereby depressing the valve stem **114** and causing fluid to be released from the container **112**. Upon completion of the spraying sequence, the motor **404** is reenergized in the counter-clockwise direction thereby causing the swing arm **506** to throw the idler gear **502** out of engagement with the first large gear **408** (see FIG. **22**). When the idler gear **502** is in a disengaged position with the first large gear **408** the internal motor tare torque and generator drag is removed from the gear train **402**, thereby allowing the actuator arm **126** to return to a pre-actuation position due to the spring **432** and the internal upward forces of the valve assembly.

With regard to the embodiments depicted in FIGS. **1-22**, the drive module assemblies may have numerous varying characteristics. For example, as noted previously, the actuator

arm **126** is driven in a direction parallel to the longitudinal axis **264** of the container **112**, however, the drive module assemblies may be modified to cause the overhang portion **174** of the actuator arm **126** to impart a force onto any area of the valve stem **114** to depress or tilt same.

It is also envisioned that different alternatives of the drive assemblies may be modified to be used in dispensers that have the ability to hold and spray one or more containers having the same or different products. Further, the drive module assemblies could spray the contents of the containers at the same time or at selected intervals and sequences.

It should be apparent to one skilled in the art that any of the disclosed module drive assemblies may be used with a dispenser having any of the structural and functional characteristics of the engagement mechanisms described in U.S. patent application Ser. No. 11/725,402. Further, it is anticipated that module dispensing mechanisms may be adapted to be used with any dispenser known in the art used to release the contents of an aerosol container.

INDUSTRIAL APPLICABILITY

The assembly described herein advantageously allows for all the components of a drive module to be mounted together, without screws, and then singularly placed into a housing of a dispenser. The snap-together features of the components and the ability to singularly place the drive module assembly into a dispenser makes the dispenser easier and more labor efficient to manufacture.

Numerous modifications will be apparent to those skilled in the art in view of the foregoing description. Accordingly, this description is to be construed as illustrative only and is presented for the purpose of enabling those skilled in the art to make and use what is herein disclosed and to teach the best mode of carrying out same. The exclusive rights to all modifications which come within the scope of this disclosure are reserved.

We claim:

1. A drive module assembly, comprising:
- a drive motor including a drive shaft;
- a gear plate including a seat for retaining the drive motor within the seat, wherein at least one support member extends from an upper surface of the gear plate toward the drive motor;
- a motor cap to engage a surface of the drive motor opposite the drive shaft and having at least one pawl for snap-fitting into the support member of the seat; and
- at least one axle, which is adapted to receive a gear.

2. The assembly of claim **1**, wherein the motor cap includes two pawls.

3. The assembly of claim **1** further including a printed circuit board assembly.

4. The assembly of claim **3**, wherein the motor cap includes at least one engagement portion adapted to retain the printed circuit board assembly.

5. The assembly of claim **4**, wherein the engagement portion includes at least one additional pawl.

6. The assembly of claim **4**, wherein the engagement portion includes at least one post.

7. The assembly of claim **1**, wherein the gear plate further includes a plurality of axles.

8. The assembly of claim **1**, wherein the at least one support member of the seat includes opposing curved support members adapted to retain the at least one pawl of the motor cap.

9. The assembly of claim **8** further including pins disposed on the seat to receive the motor.

10. The assembly of claim **9** further including holes disposed on a side of the motor to mate with the pins on the seat.

11. The assembly of claim **7**, wherein the assembly is manufactured as a single unit and can be singularly inserted into a dispenser.

12. A method for assembling a drive module, comprising the steps of:
- providing a gear plate with a seat for a motor having a drive shaft, at least one axle, and at least one support member extending from an upper surface of the gear plate;
- retaining the motor within the seat, wherein the at least one support member extends toward the motor;
- providing a motor cap with at least one pawl, wherein the at least one pawl snaps into the support member of the seat and the motor cap covers a surface of the motor opposite the drive shaft; and
- disposing a gear train on the at least one axle.

13. The method of claim **12**, wherein the step of retaining the motor within the seat further includes the step of snapping a motor cap into the gear plate over the surface of the motor opposite the drive shaft.

14. The method of claim **13**, wherein the step of retaining the motor within the seat further includes the step of mating holes disposed on a side of the motor with pins disposed on the seat.

15. The method of claim **12**, further including the step of providing a printed circuit board assembly.

16. The method of claim **15**, further including the step of providing at least one engagement portion adapted to retain the printed circuit board.

17. A dispensing system, comprising:
- a housing;
- a container having a product therein; and
- a drive module assembly adapted to release the product from a dispensing system, the drive module assembly comprising:
  - a drive motor including a drive shaft;
  - a gear plate including a seat for retaining the drive motor, wherein at least one support member extends from an upper surface of the gear plate toward the drive motor;
  - a motor cap to engage a surface of the drive motor opposite the drive shaft, the motor cap having two pawls disposed on a bottom side for snap-fitting into the at least one support member of the seat, and two pawls extending from an upper side of the motor cap;
  - at least one axle, which is adapted to receive a gear.

18. The assembly of claim **17**, further including at least one gear.

19. The assembly of claim **17**, wherein the at least one support member of the seat includes opposing curved support members adapted to retain the two pawls of the motor cap.

20. The assembly of claim **17** further including holes disposed on a side of the motor to mate with pins disposed on the seat.

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